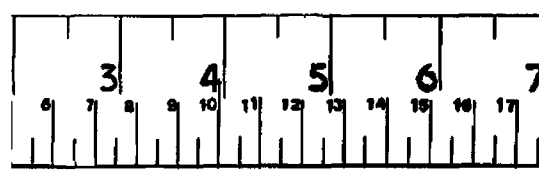
LIVE MS.

LUME 396.



GENEALOGICAL

TABLES

OF THE

Deities, Princes, Heroes, and Remarkable Personages,

OF THE

HINDUS,

EXTRACTED FROM

THE SACRED WRITINGS OF THAT PEOPLE.

WITH AN

INTRODUCTION AND INDEX,

BY

FRANCIS HAMILTON, M.D.

FELLOW OF THE ROYAL SOCIETIES AND OF THE SOCIETIES OF ANTIQUARIES OF LONDON AND EDINBURGH; AND OF THE ASIATIC SOCIETY OF CALCUTTA.

EDINBURGH:

PRINTED FOR THE AUTHOR, BY WILLIAM AITKEN.

1819.

TO HIS GRACE

JAMES DUKE OF MONTROSE, K.G.

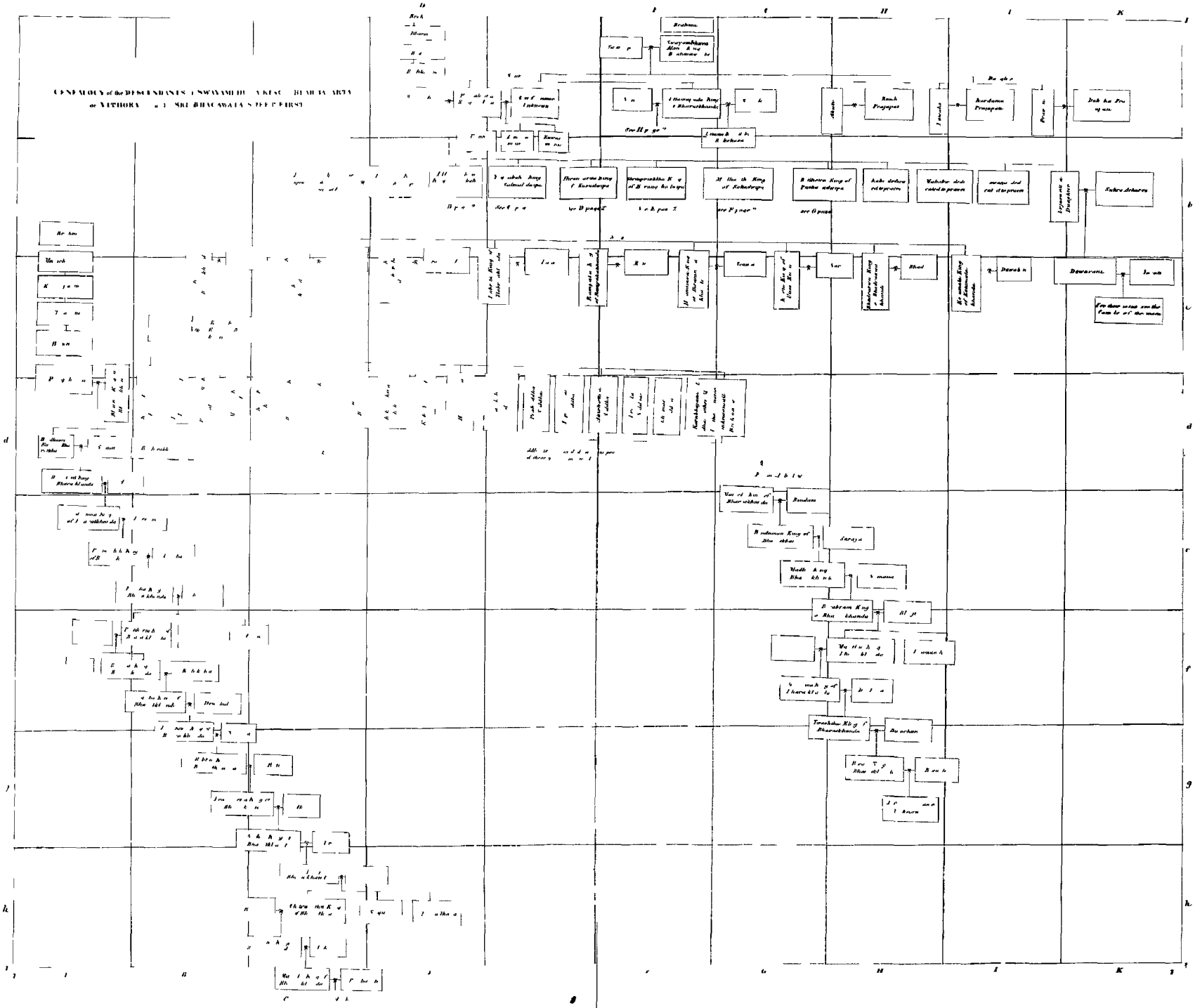
LORD LIEUTENANT OF STIRLINGSHIRE,

&c. &c. &c.

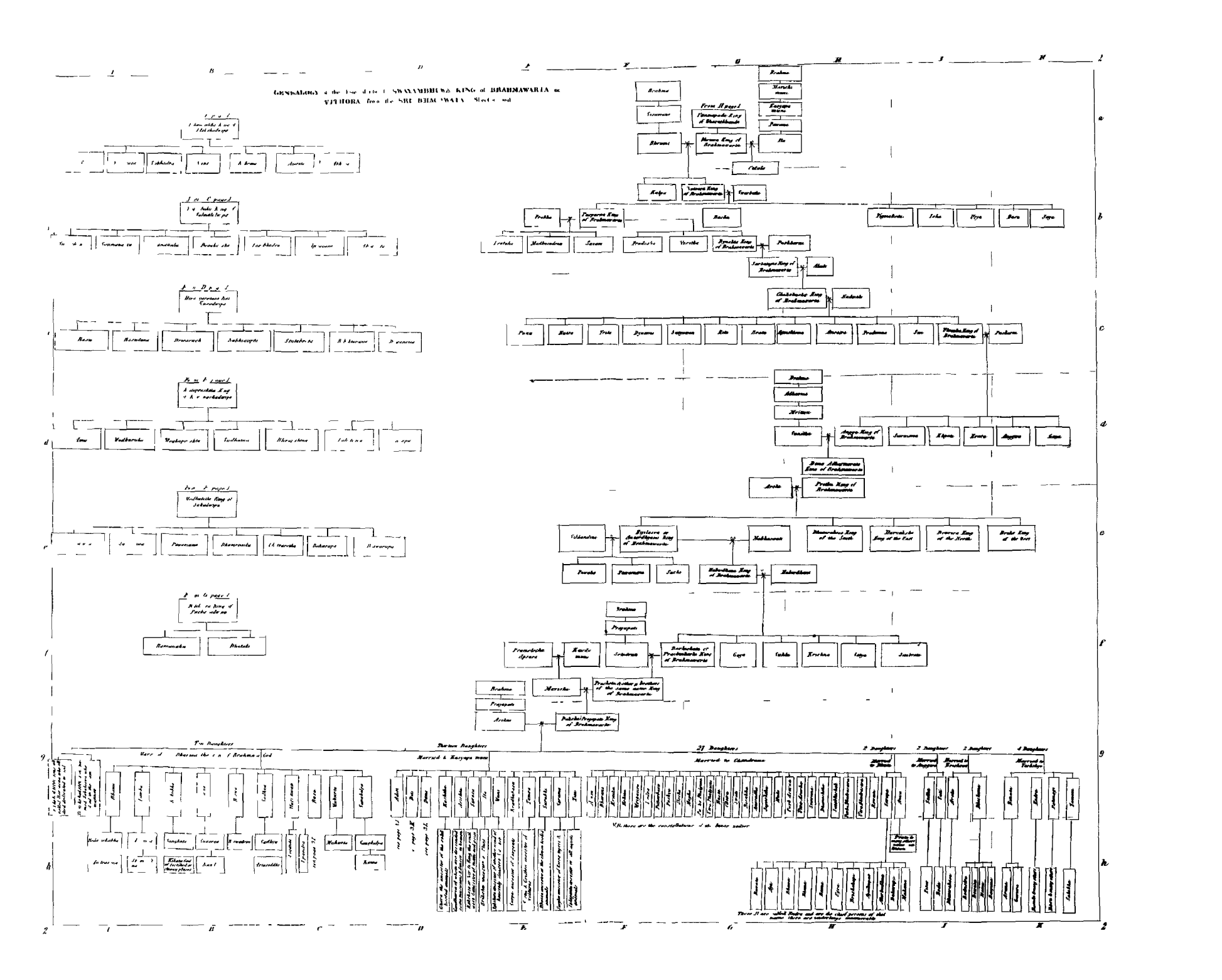
THIS WORK,

AS A MARK OF THE AUTHOR'S HIGH RESPECT,

IS MOST HUMBLY DEDICATED.

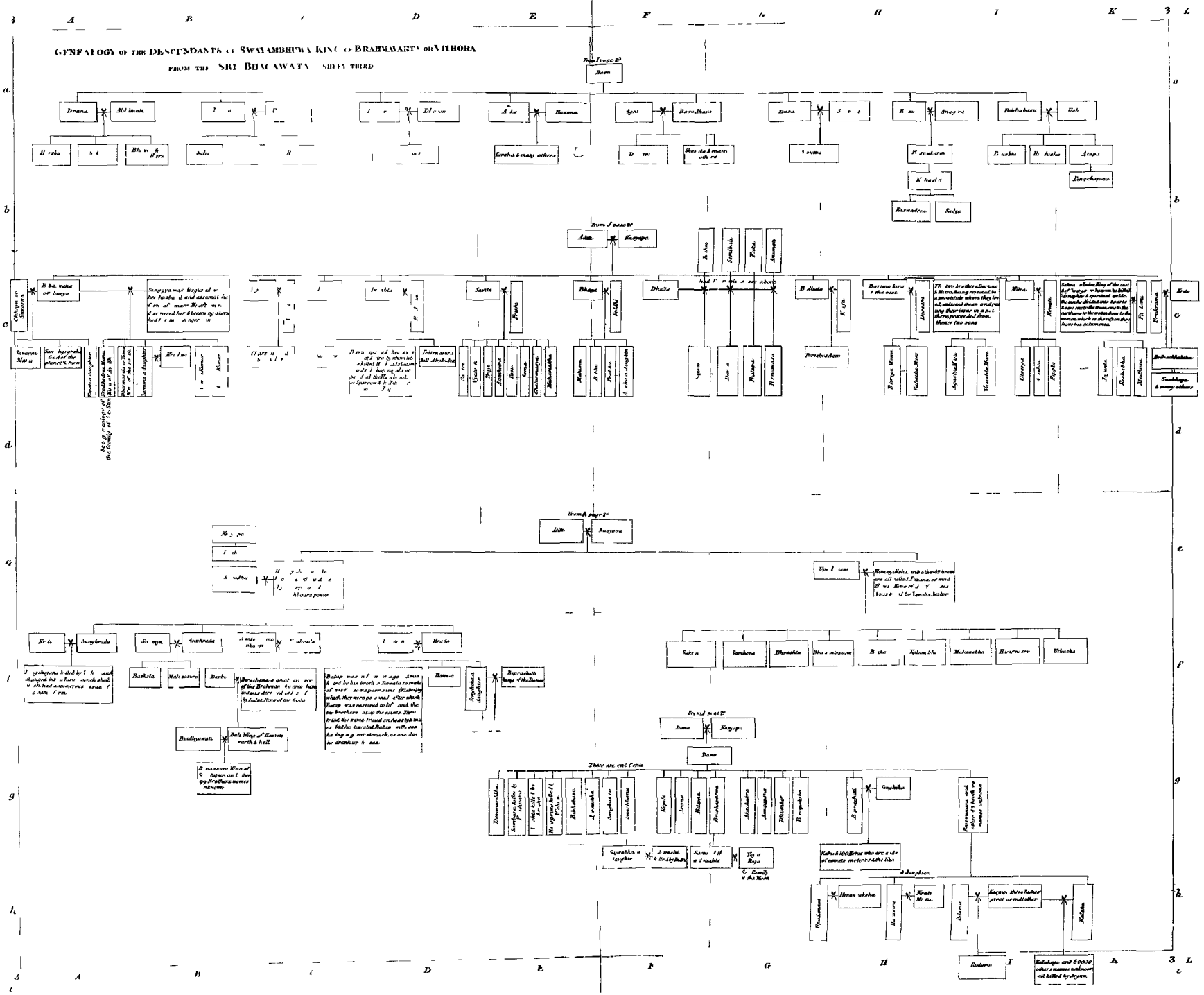


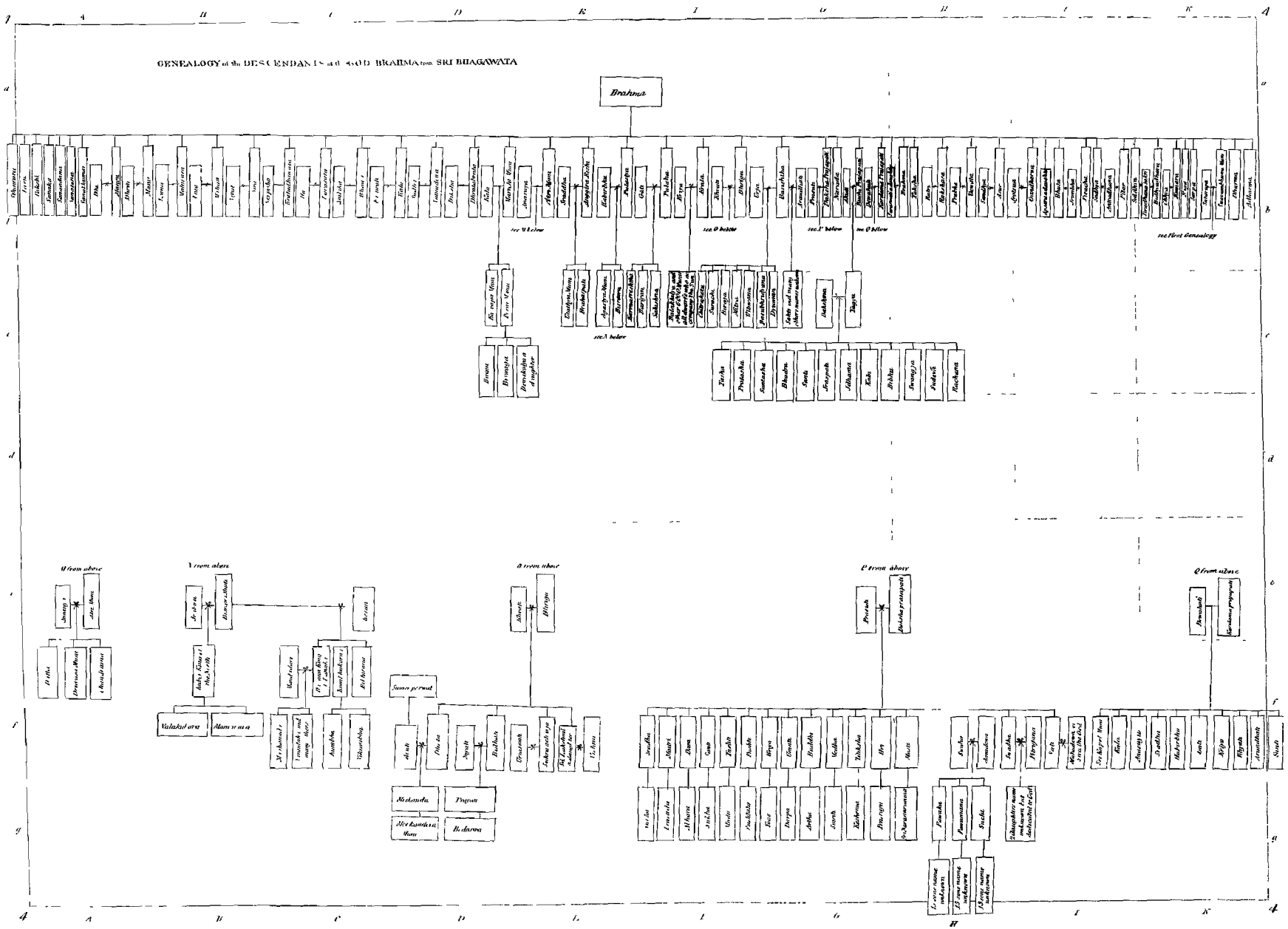
GENEALOGY of the line of descent of SWAYAMBHUVA KING of BRAHMAWARTA or VITHORA from the SRI BHAGWATA Skanda and

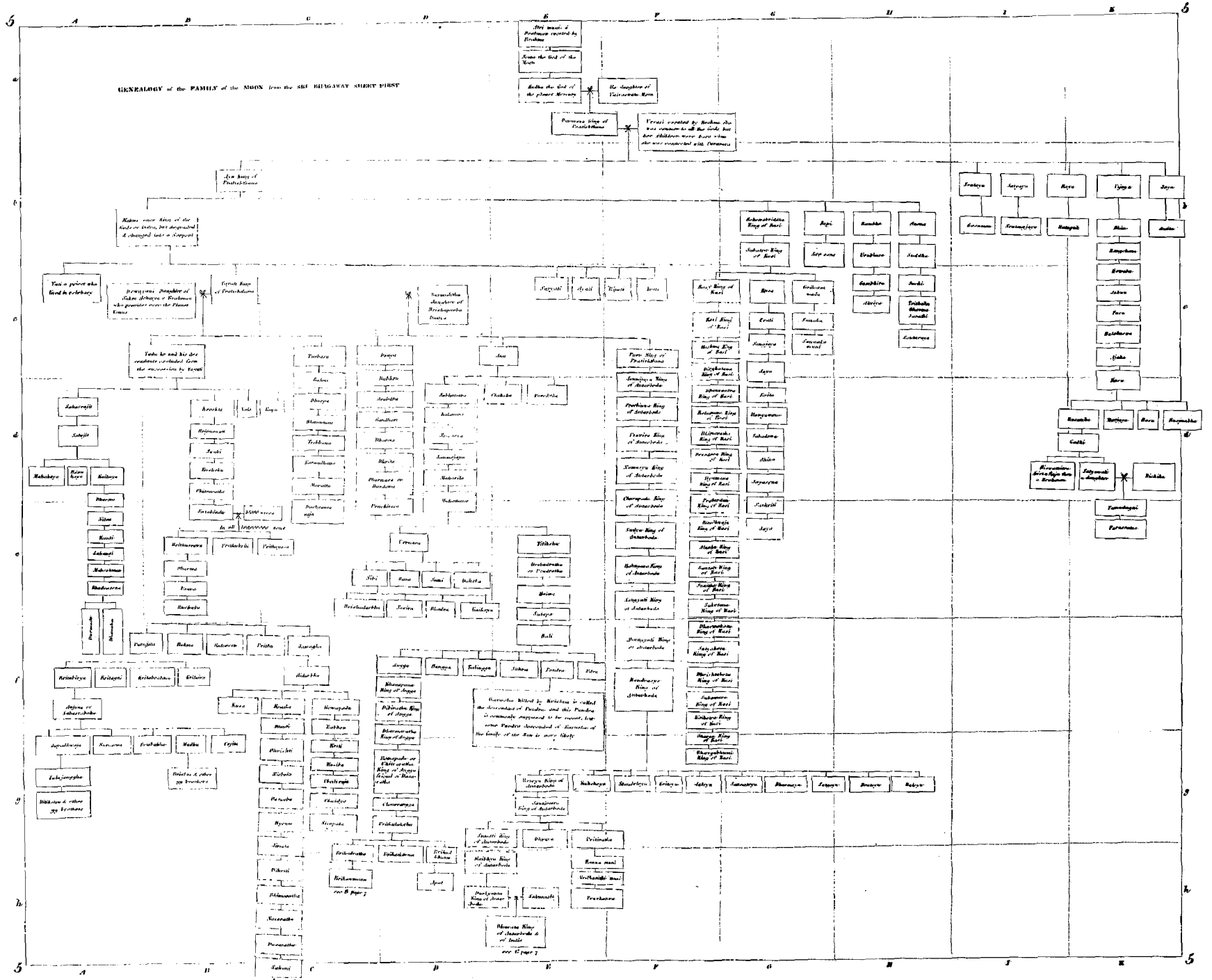


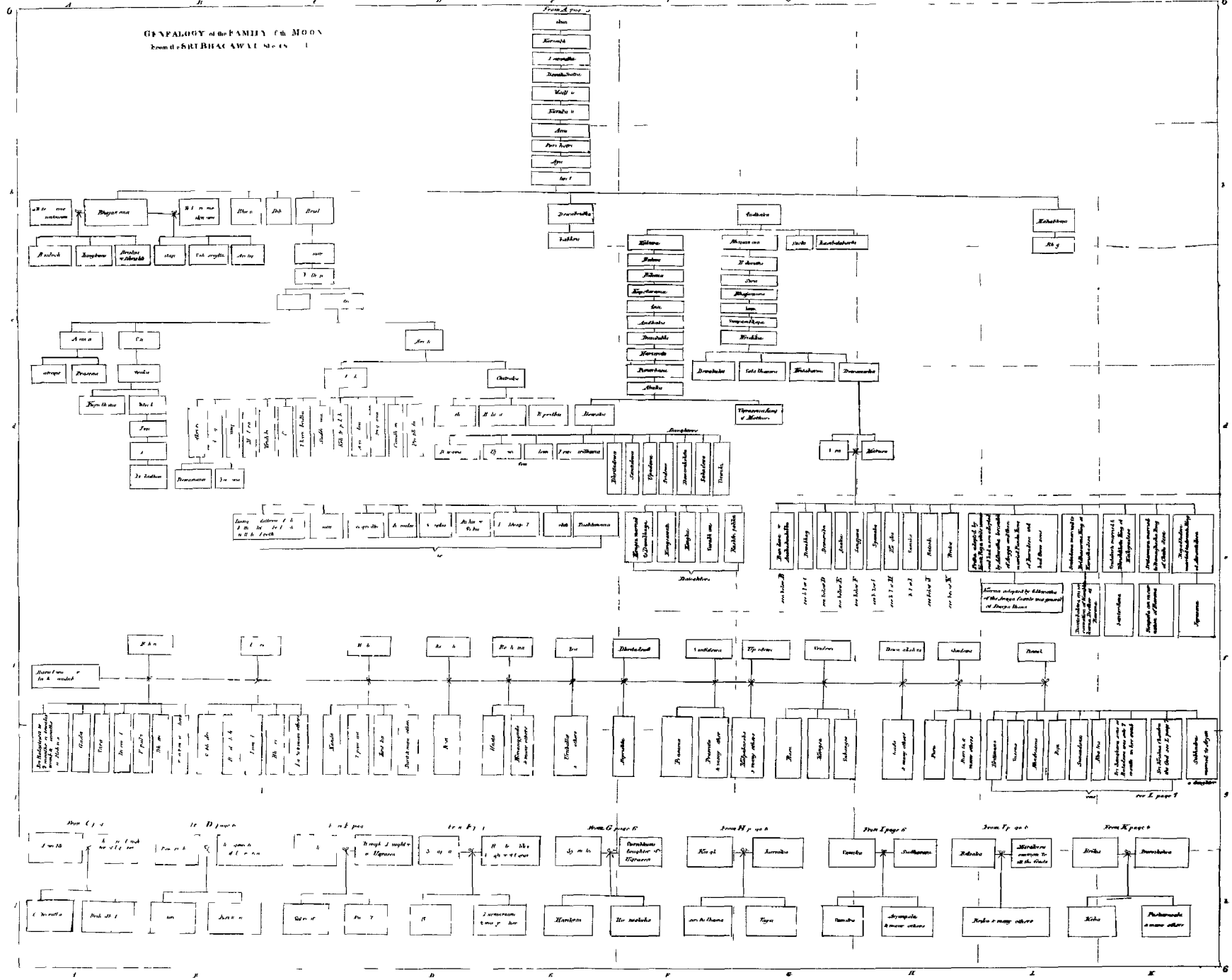
GENEALOGY OF THE DESCENDANTS OF SWAYAMBHUWA KING OF BRAHMAVARTA OR VITHORA

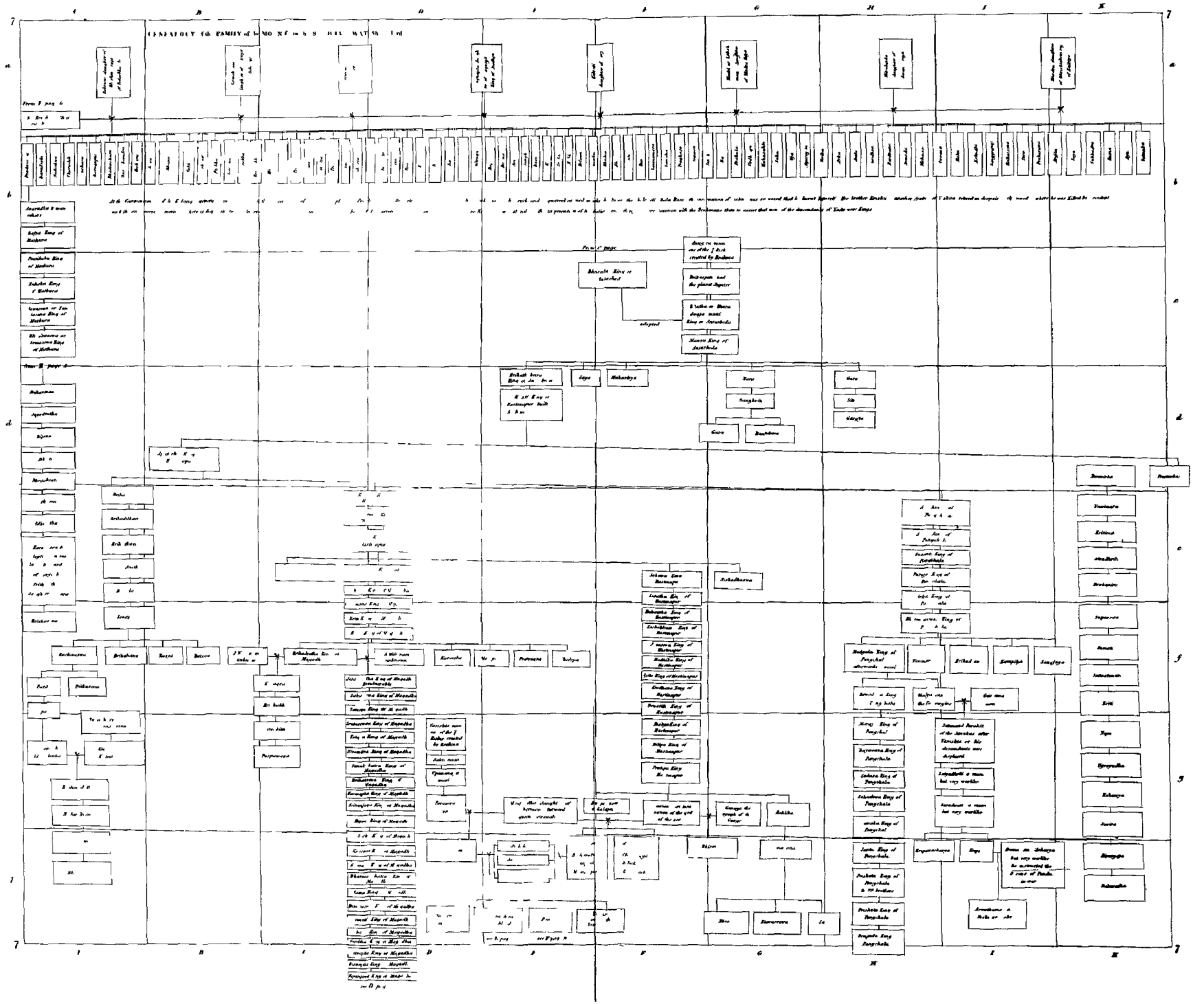
FROM THE SRI BHAGAWATA SKHA THIRD

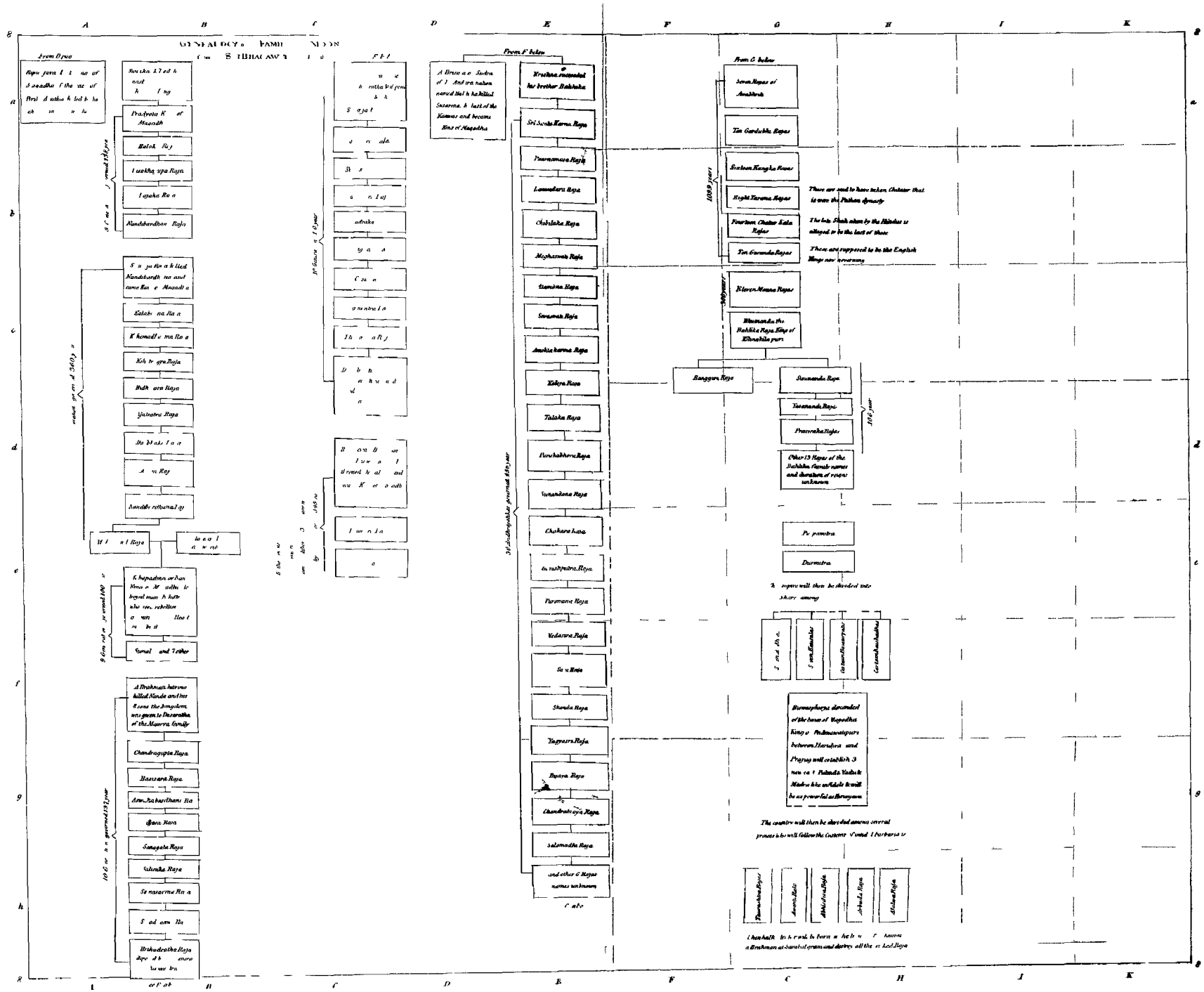


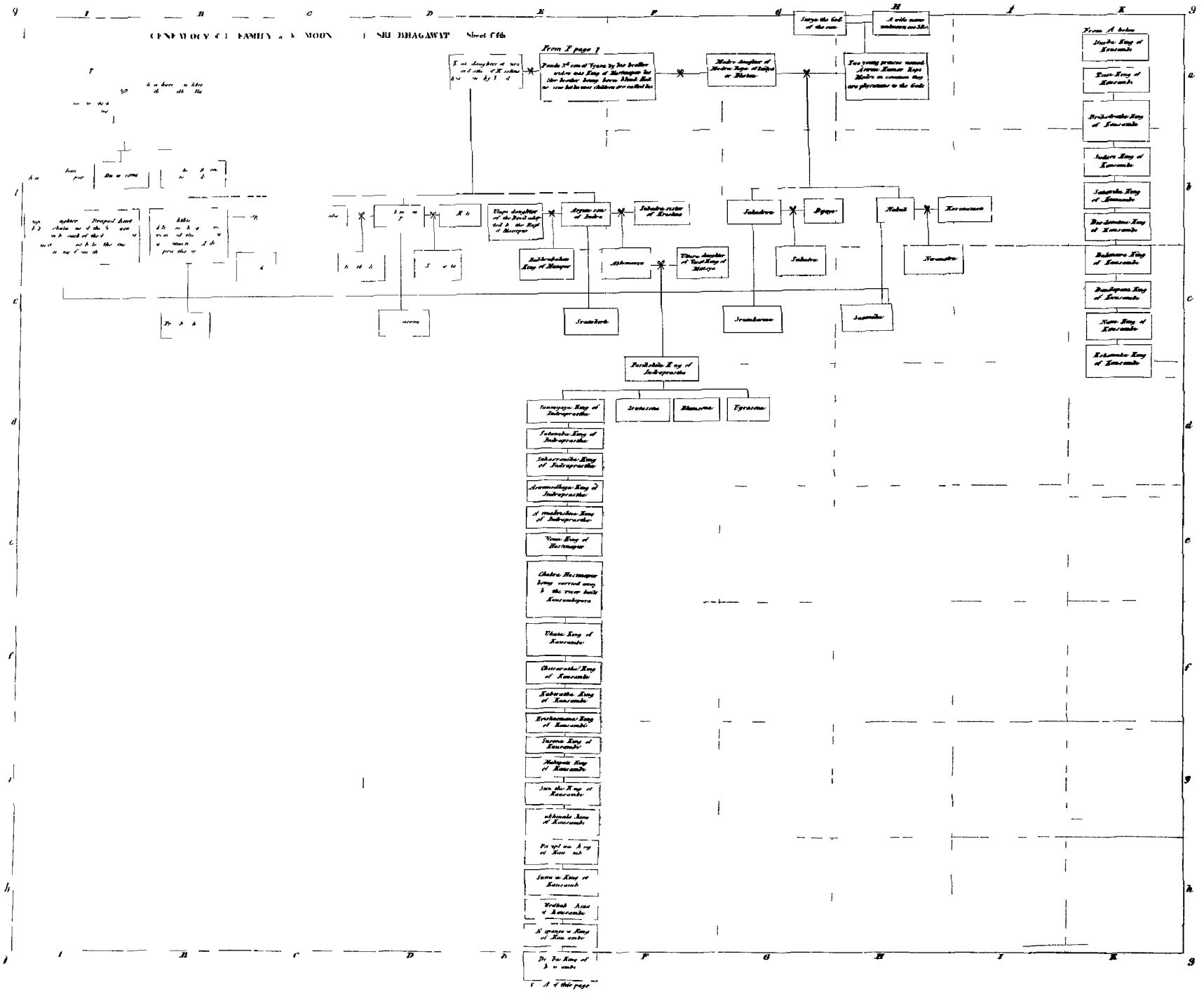

GENEALOGY of the DESCENDANTS of GOD BRAHMA from SRI BHAGAWATA
Brahma

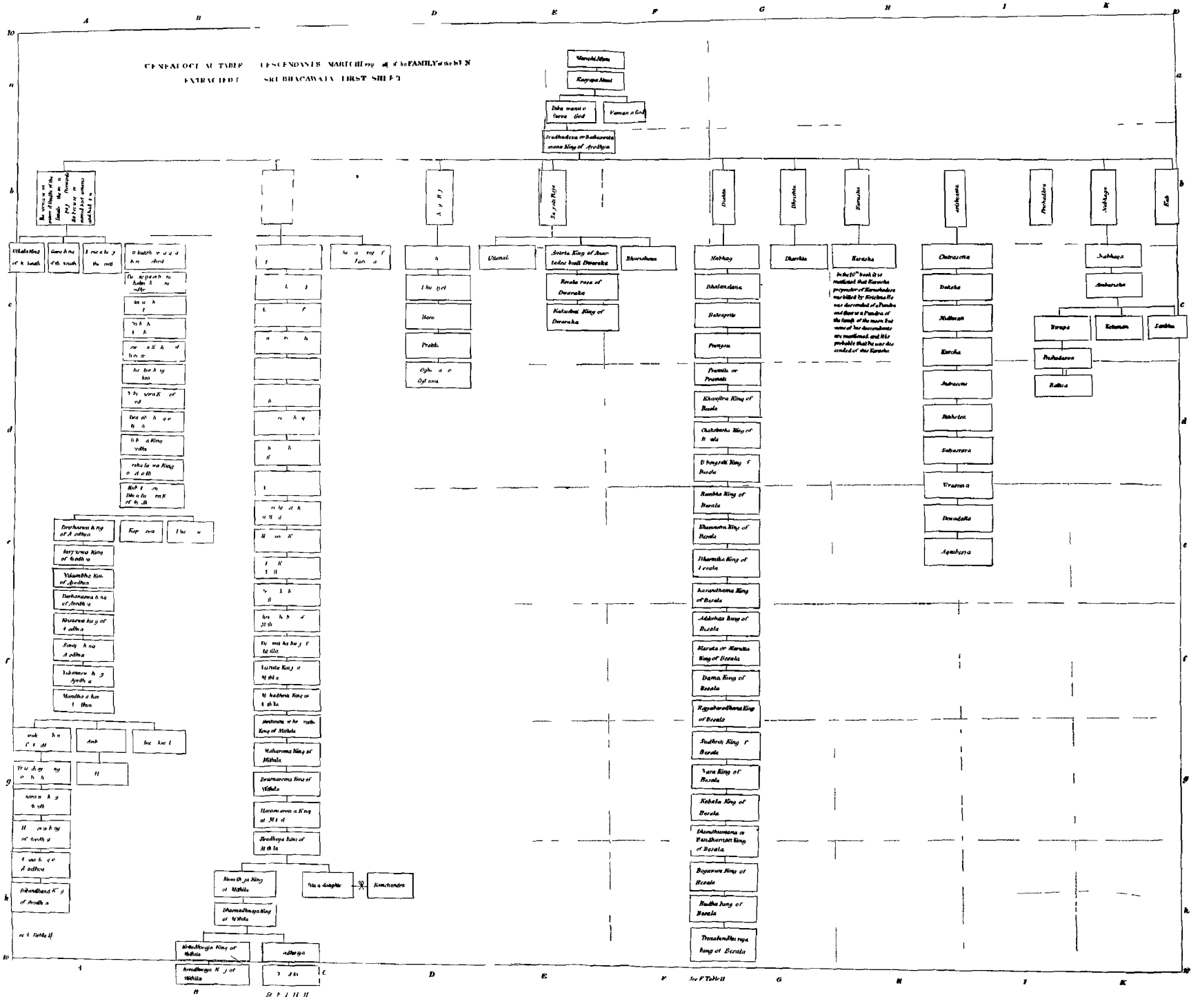

GENEALOGY of the FAMILY of the MOON from the SRI BHAGVAT SHEET FIRST
Atri
Anasuya
Soma
Vijaya
Jaya
Budha the God of the planet Mercury
Ila daughter of Vaivaswata Manu
Pururava
Urvasi
Ayu
Nahusa
Yati
Yayati
Devayani
Sarmishtha
Puru
Yadu
Sahasrajith
Kroshtu
Nila
Anu
Druhyu
Turvasu
Ajamidha
Sudhanu
Sunahotra
Kritimat
Ayu
Satyayus
Ruchi
Raya
Anenas
Pratikshatra
Sanjaya
Kshemaka
Vitihotra
Bharata
Suhotra
Hasti
Ajamidha
Kuru
Parikshit
Janamejaya
Shatanika
Udayana
Vasavadatta
Padmavati
Nemichakra
Ahinara
Chitraratha
Shuchidratha
Vrishnimat
Shini
Satyaki
Yuyudhana
Kunti
Vasudeva
Devaki
Krishna
Balarama
Subhadra
Abhimanyu
Parikshit
Janamejaya
Shatanika
Sahasran

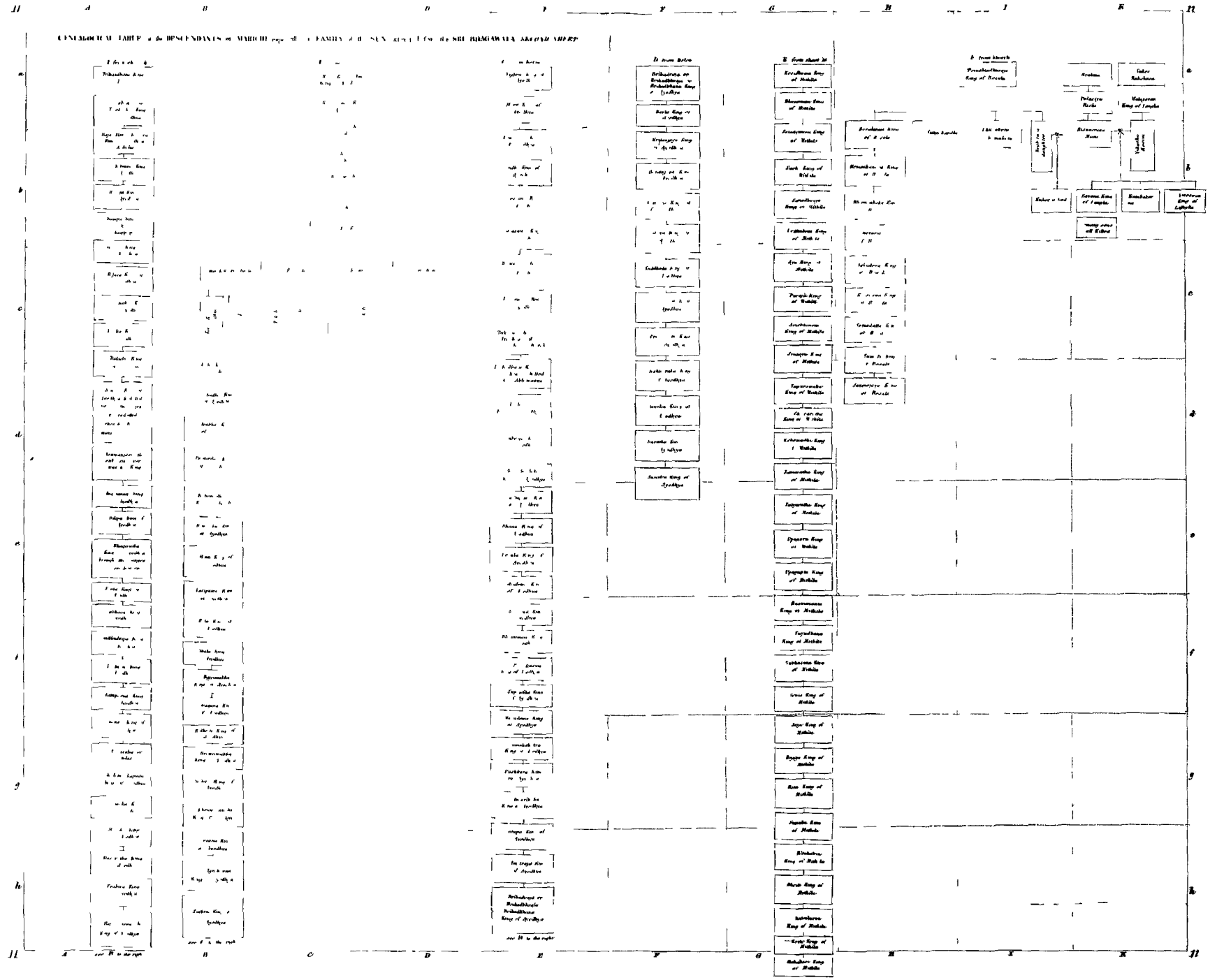

GENEALOGY of the FAMILY of the MOON
from the SRI BHAGAWAT Shasta

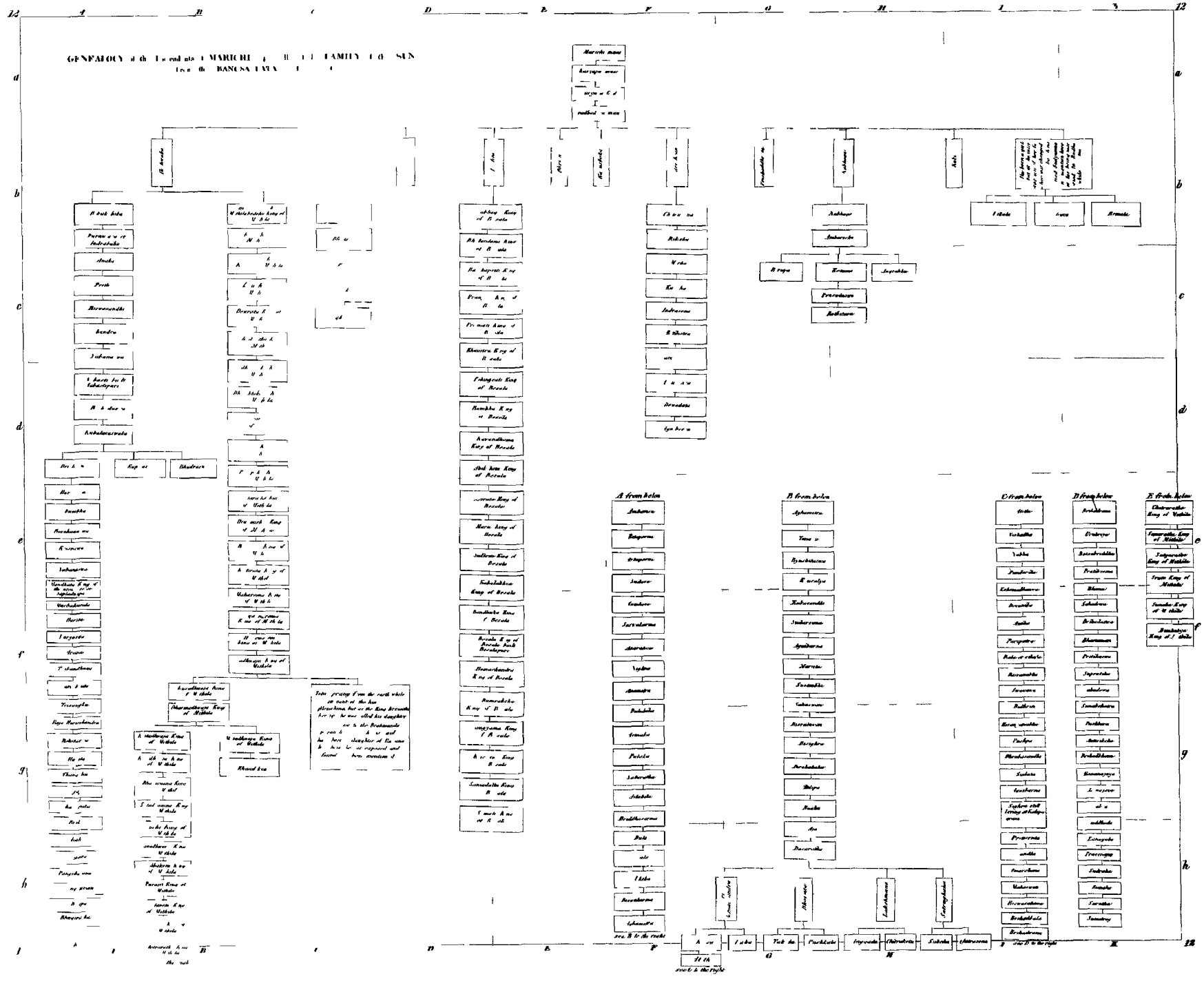


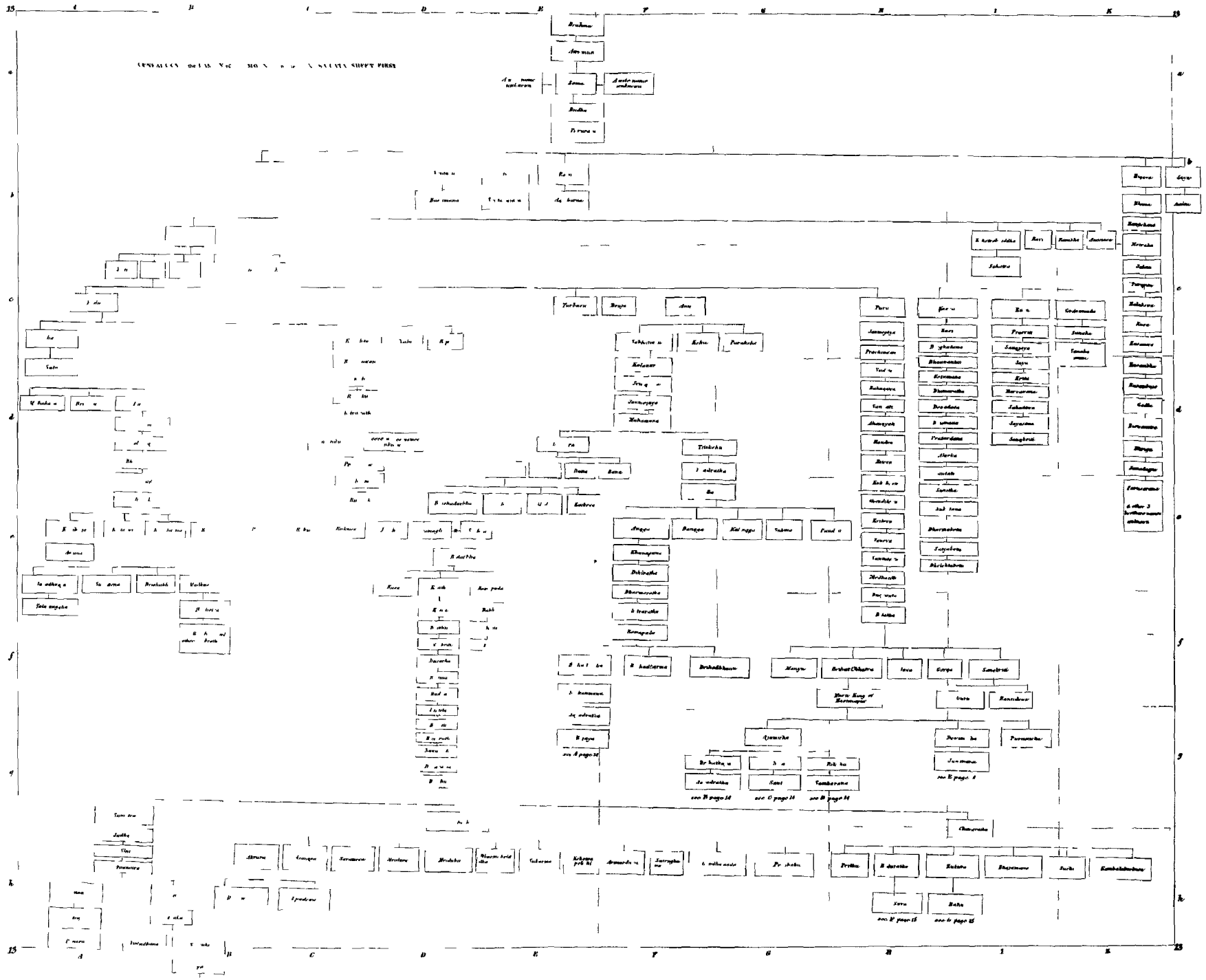

From Dipuva
Sunaka 37 ed h
nast
h f ng
Pradyota K of
Magadh
Balak Raj
Visakha upa Raja
Ajaka Ra a
Nandivardhan Raja
S u ga Kn a killed
Nandivardh na and
came Ku e Magadh a
Kalaka na Ra a
K kemadh rma Ra a
Kshe tr ujra Raja
Kshe ma Raja
Vajratra Raja
Su bhaka Ra a
A ri Raj
Anandakarnuna Raja
W l n l Raja
Ku e a l
a w ed
K hapadma ardhan
Nina e M ndha le
legal mun h hate
who rev. rekshan
a um Use t
na e d
Kunal and Tejpar
A Brahmin hatrina
killed Nanda and his
8 sons the kingdom
was given to Parasvatha
of the Maurya family
Chandragupta Raja.
Bassara Raja.
Arm...kapavithani Ra
Bana Rana
Sanagata Raja
Vikrama Raja
Satrusarma Ra a
S od ama Ra
Brihadratha Raja
Sige d b mara
Su ma bra
From F below
A Brata a e Sudra
of I And ra naban
narued Bal h ka killed
Susarma. h last of the
Kanwas and becam
Kings of Magadha.
Krishna succeeded
his brother Balakrishna.
Sri Santa Karna Raja
Pournamasa Raja
Lamodara Raja
Chibilaka Raja
Meghaswati Raja
Hamsana Raja
Swaswati Raja
Amrita karma Raja
Kshitja Raja
Talaka Raja
Purushabhiru Raja
Vinandana Raja
Chakora kara
Su nakhipatra Raja
Purnamani Raja
Vedasiras Raja
Su u Raja
Skanda Raja
Yagnasiras Raja
Vijaya Raja
Chandrabhoja Raja
Satamadha Raja
and other 6 Rajas
names unknown
From G below
Seven Rajas of
Andhrak
Ten Gardabhi Rajas
Sixteen Kanaka Rajas
Eight Turuna Rajas
There are said to have taken Chatoor that is now the Patan dynasty
Fourteen Chatur Sala Rajas
The lady Shah whom by the Hindus is alleged to be the last of these
Ten Gurunda Rajas
These are supposed to be the English Kings now reverning
Eleven Mauna Rajas
Bhumanda the Bahlika Raja. King of Ekmahila puri
Ranggura Raja
Sunanda Raja
Yasanandi Raja
Prasvatha Rajas
Other 13 Rajas of the Bahlika family names and duration of reign unknown
Purnabhadra
Durmitra
The empire will then be divided into
shares among
Sumatikirti
Sri vasu Bhandalaka
Satanika Rajasreyaputra
Satanika Anantha
Bimbasaraputra descended
of the house of Nagadha
King of Pushpamalapura
between Harishtra and
Prayaga will establish 3
new cities Pataliputra Vaishali
Madra like unto Kailasa It will
be as powerful as Sumeru mountain
The country will then be shared among several
princes who will follow the Customs of noted Barbarians
Purnotsaha Raja
Ananda Rishi
Akhilakarna Raja
Sukhala Raja
Sukhada Raja
Thus half the world be born and bred in the house of
a Brahman at Sambhal gram and destroy all the wicked Rajas

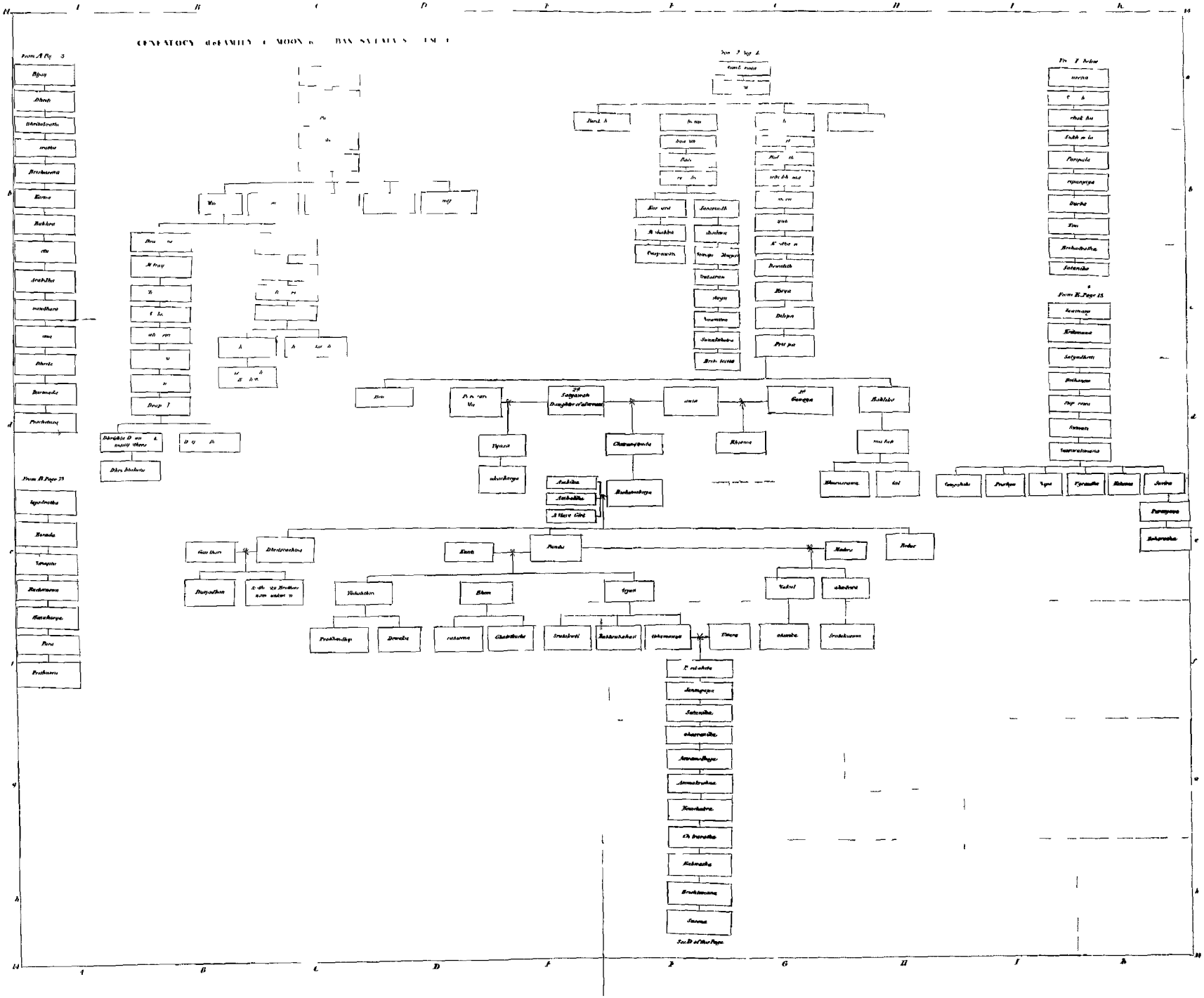

GENEALOGY of the FAMILY of the MOON from SRI BHAGAWAT Sheet 5th
From F page 1
From A below
Satyaka the God of the sun
A wife name unknown see Sh.
Madra daughter of Madra Raja of Salipa or Marica
Two young princes named Aswini Kumara Raja Madra in common they are physicians to the Gods
Uparicharu King of Kausamba
Vasu King of Kausamba
Pratisrabratha King of Kausamba
Sudara King of Kausamba
Subahu King of Kausamba
Bhu-Jamana King of Kausamba
Rajamana King of Kausamba
Dandapani King of Kausamba
Nara King of Kausamba
Kshemaka King of Kausamba
Sahadeva
Sagara
Nakul
Karumana
Sahadeva
Niramitra
Srutakirti
Srutakarma
Jasumitra
Parikshita King of Indraprastha
Janmejaya King of Indraprastha
Srutasena
Bhimasena
Ugrasena
Satanika King of Indraprastha
Sahasranika King of Indraprastha
Aswamedhaja King of Indraprastha
Asimakrishna King of Indraprastha
Nemi King of Hastinapur
Chakra Hastinapur being carried away by the river built Kausambipura
Ukasa King of Kausamba
Chitrarathe King of Kausamba
Kabiratha King of Kausamba
Brishanamas King of Kausamba
Susena King of Kausamba
Mahapati King of Kausamba
Sunu the King of Kausamba
Nichanale King of Kausamba
Parapti na King of Kausamba
Sunu a King of Kausamba
Vrithali King of Kausamba
Nripanja a King of Kausamba
Di Pati King of Kausamba
A of this page

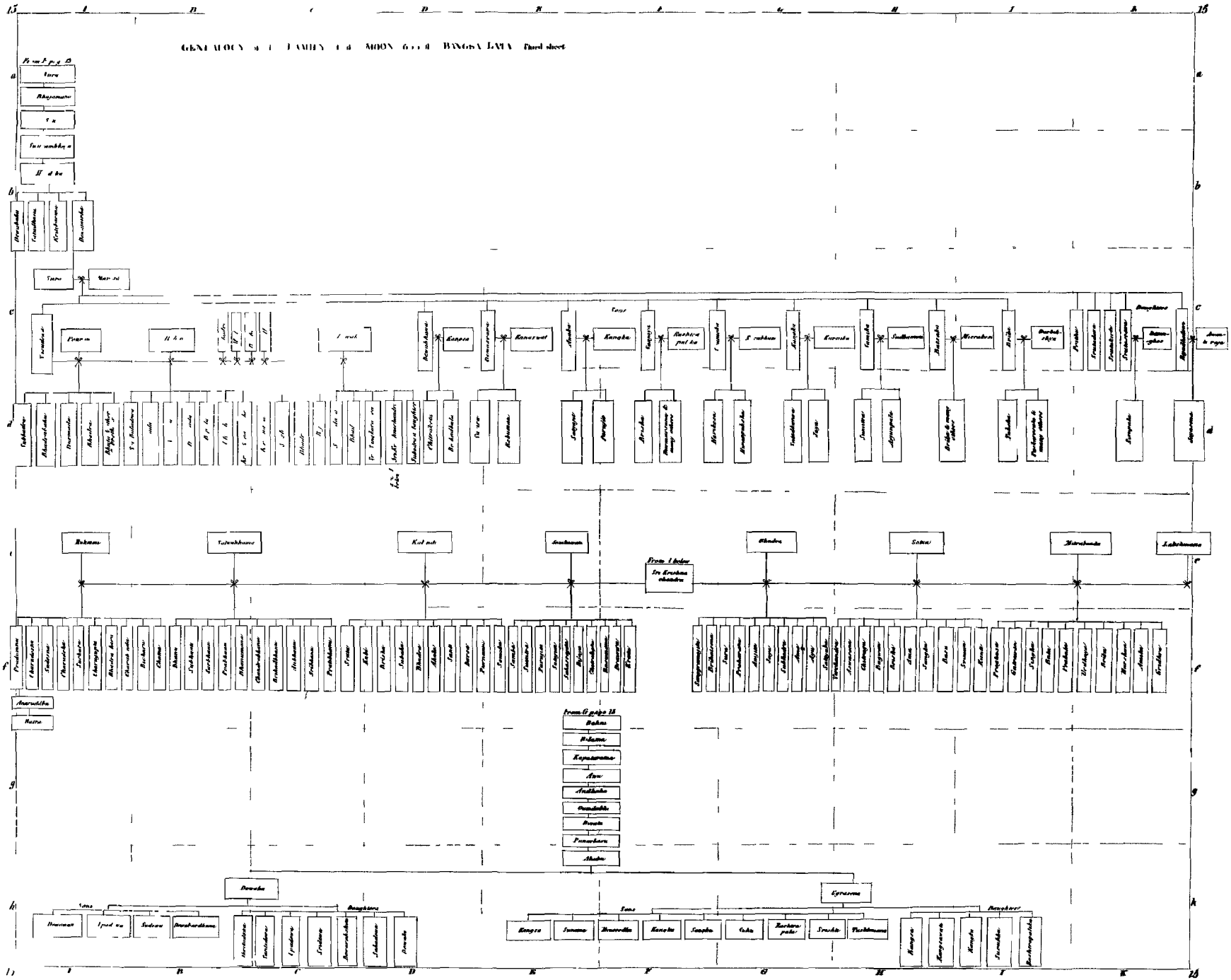

GENEALOGICAL TABLE OF DESCENDANTS OF MARICHI &c. &c. OF THE FAMILY OF THE SUN
EXTRACTED FROM SRI BHAGAWATA FIRST SKHANDA
Vaivaswata Manu
Ikshwaku
Vikukshi
Banabasa
Anaranya
Prithu
Trisanku
Harischandra
Rohitaswa
Harita
Chanchu
Vijaya
Ruruka
Vrika
Bahu
Sagara
Asamanjasa
Ansumanta
Dilipa
Bhagiratha
Sruta
Nabhaga
Ambarisha
Sindhudwipa
Ayutayus
Rituparna
Sarvakama
Sudasa
Mitrasaha
Asmaka
Moolaka
Dasaratha
Ilavila
Viswasaha
Khatwanga
Dirghabahu
Raghu
Aja
Dasaratha
Rama
Kusa
Atithi
Nishadha
Nala
Nabha
Pundarika
Kshemadhanwa
Devanika
Ahinagu
Paripatra
Dala
Chhala
Uktha
Vajranabha
Sankhana
Vyushitaswa
Viswasaha
Hiranyanabha
Pushya
Dhruvasandhi
Sudarsana
Agnivarna
Sighra
Maru
Prasusruka
Amarshana
Mahaswat
Visrutavat
Vrihadbala
Urukshaya
Vatsavyuha
Prativyoma
Bhanu
Senajit



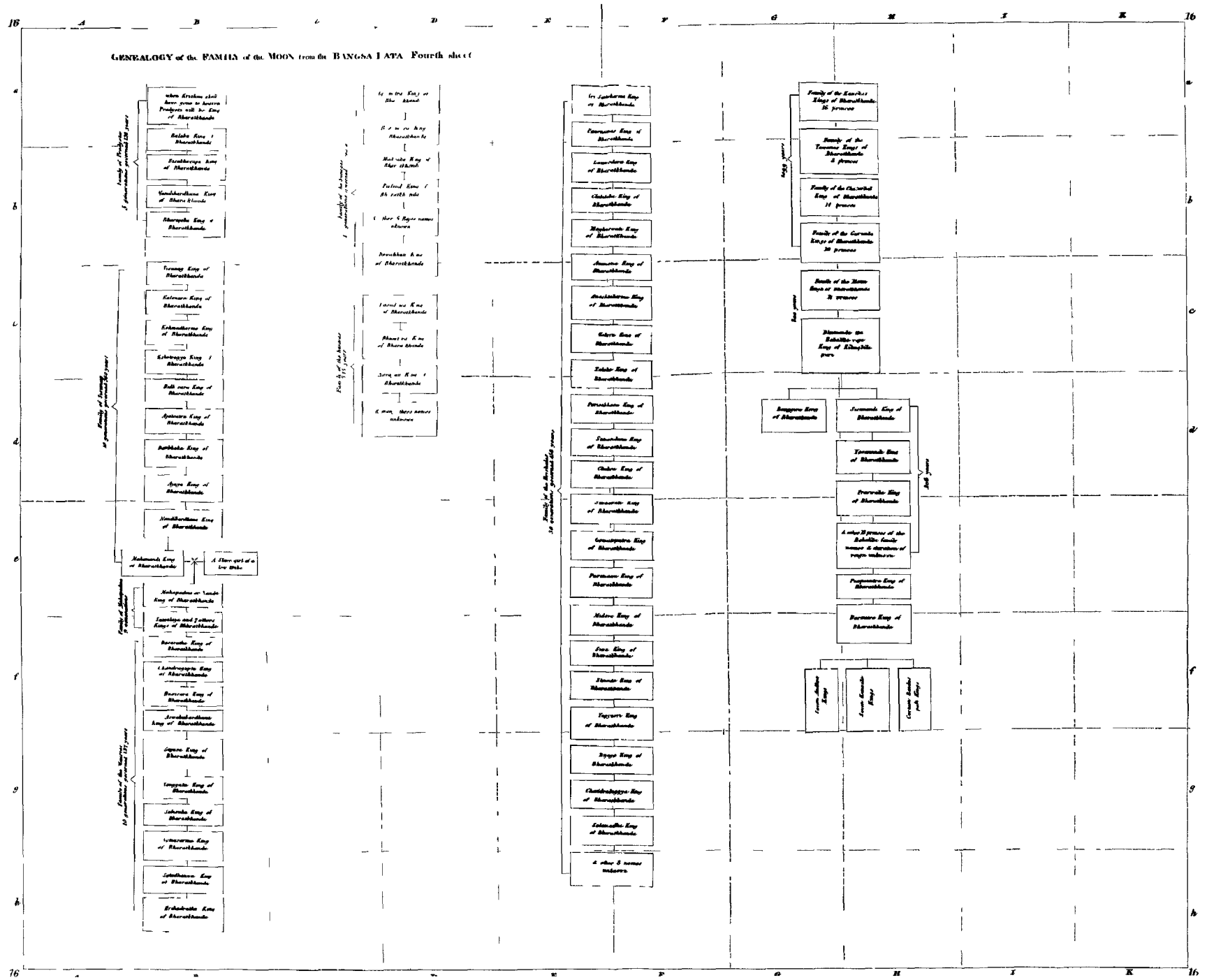


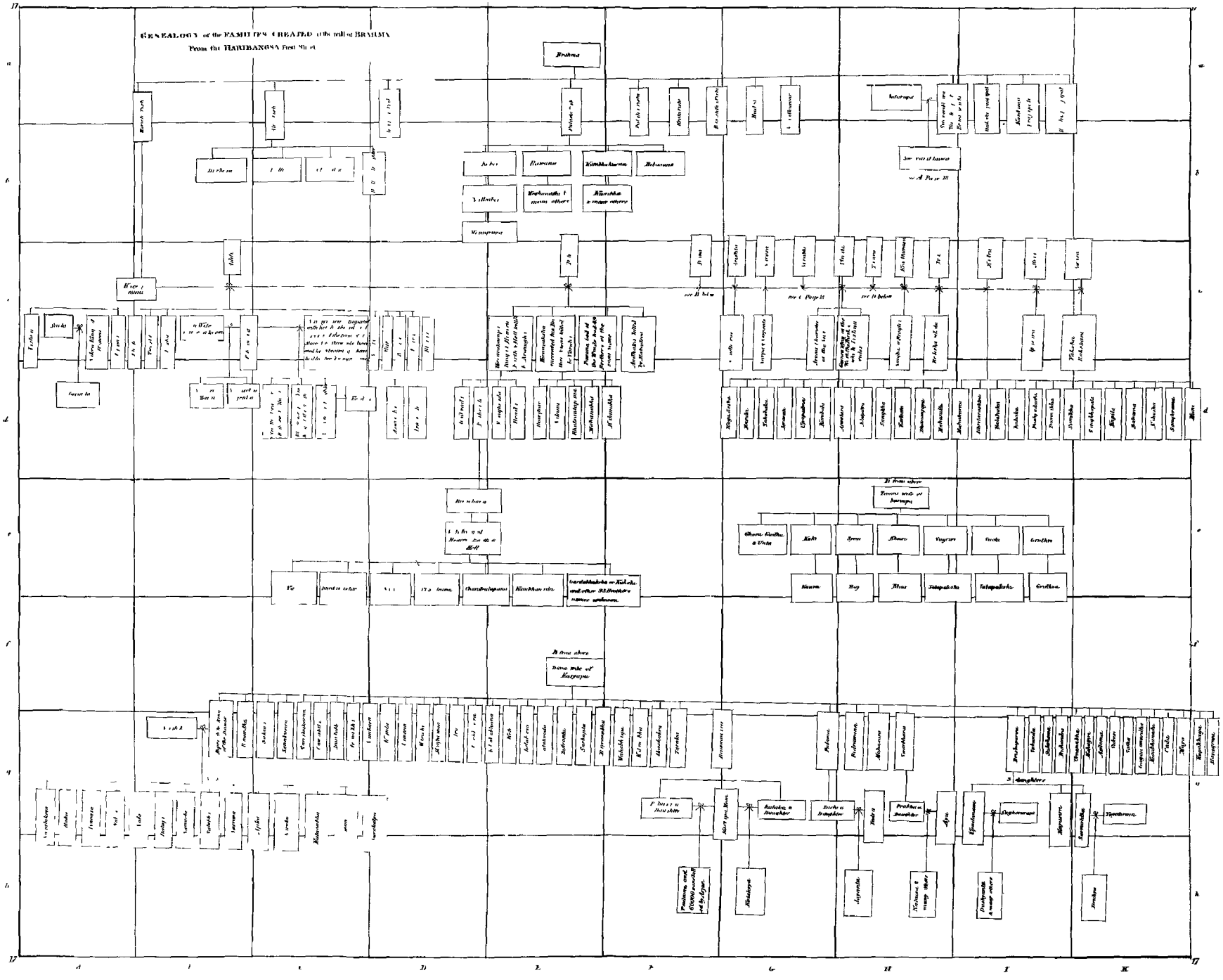




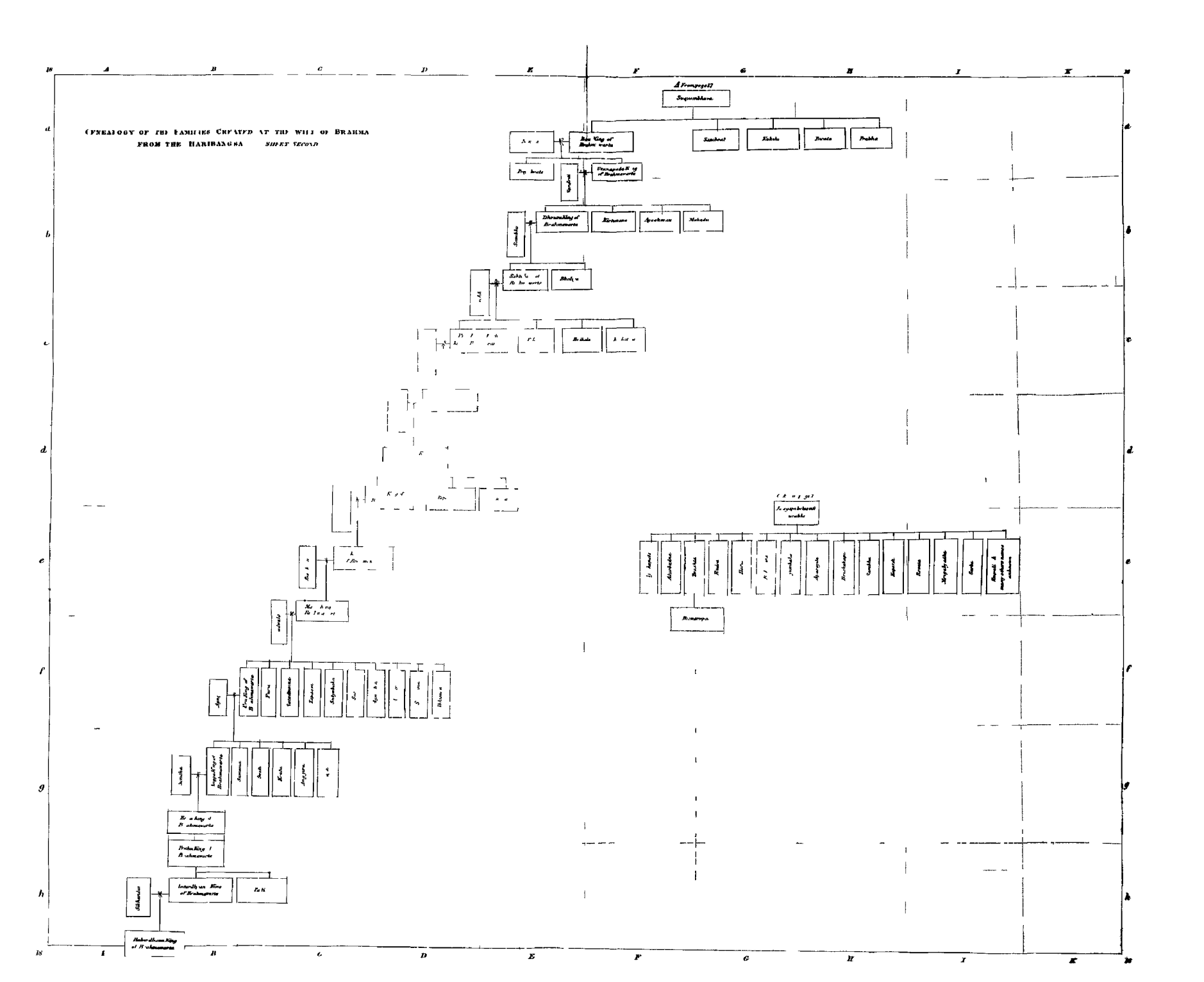


GENEALOGY of the FAMILY of the MOON from the BANGSA LATA Fourth sheet




GENEALOGY of the FAMILIES CREATED of the will of BRAHMA
From the HARIVANSA First Sloka
Brahma

GENEALOGY OF THE FAMILIES CREATED AT THE WILL OF BRAHMA FROM THE HARIBANGSA *SHEET SECOND*


Sugreebhkarna
Sambhoo
Kokuku
Baruta
Prabha
Dhurmukhing of Brahmawurtu
Kirtumana
Ayushmun
Mahadu
Bhuriu
Brihadu
Mahabhoo
Kusagoobhumb wrubhu
Ambarishu
Brishtu
Rishu
Dhrishtu
Kurusu
Purushu
Sutejus
Vusoomunu
Supratheekus
Ghrishtu
Mudrukus
Kuvuchi
Nuvuguntha
Bahu
Sumuh & many others named unknown
Bhumunyu
Ajumeedhu
Kuvuchi
Purujunu
Mahuhing
Rikshu
Sumuntu
Hiruneenabha
Kusika
Kusanabha
Gadhi
Kousiku
Kousiku
Kousiku

GENEALOGY, of the FAMILIES CREATED at the WILL of BRAHMA, from the HARIBANGSA. Third Sheet.

E From Page 2

Bhishma — Kshiridhuma king of Brahmanarta.

Prachinbarhi king of Brahmanarta — Sudra — Gaya — Krishna — Bhoja — Ajina

Sakarna

Narishta — Prachita e g brothers named Pracheta

Ankini — Dakcha prajapati

1st Daughter married to Dharma

27 Daughters married to Chandrama

Issue

Seven Sons of Dharma name Marugawa.

1000 Sons of Dharma name Sabalasua

Vrandhata, Rasa, Sena, Lanka, Dhara, Manohari, Sanadripa, Nimesh, Sudhya, Patava, Aswini, Bharani, Krittika, Rohini, Mrigasira, Ardra, Punarbasu, Pushya, Aslesha, Magha, Purba phalguni, Uttra phalguni, Hasta, Chitra, Swati, Bisakha, Anuradha, Jyeshtha, Mula, Purba ashada, Uttra ashada, Sravana, Dhanishtha, Satabhisha, Purba Bhadrapada, Uttra Bhadrapada, Revati, 1000 Sisters & Daughters name unknown.

Apa — Bahhaya — Srama — Dranta — Muni

Dhruva — Kala

Soma — Barchas

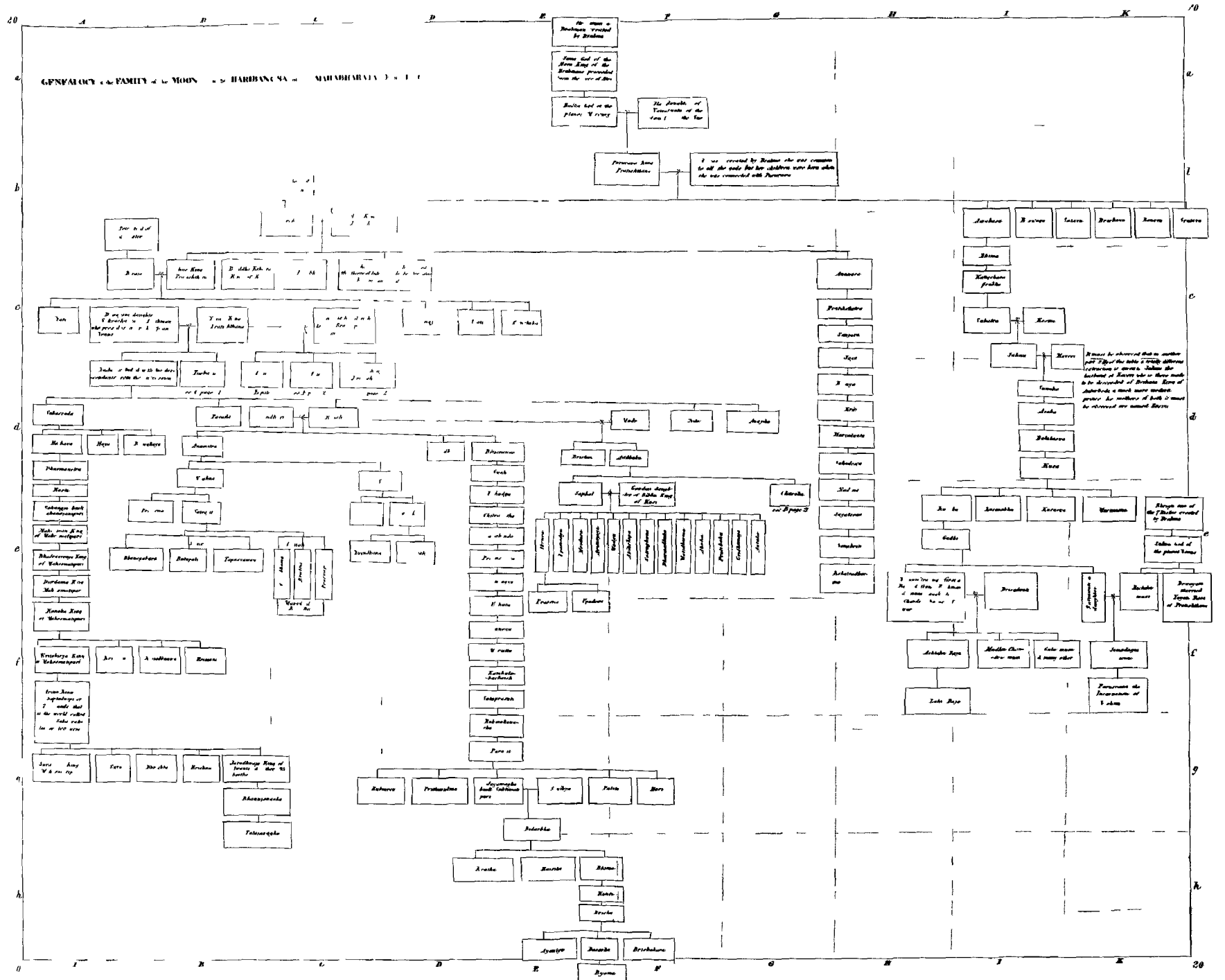
Dhara — Dravina — Huta — Hutayavaha — Vitiva — Pratna — Ravana

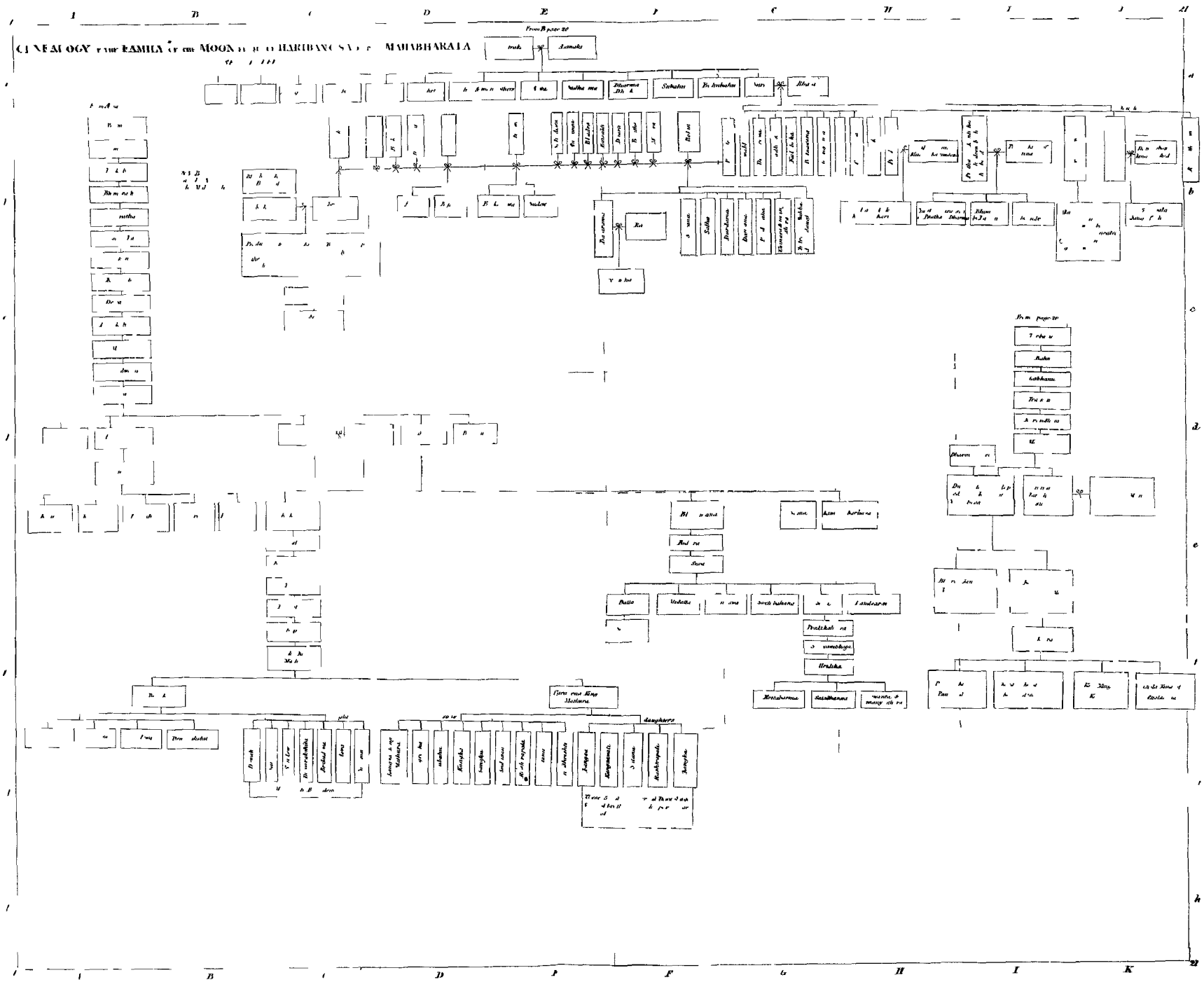
Anila — Manojava — Avijnatagati

Anala — Kumar — Sakha — Visakha

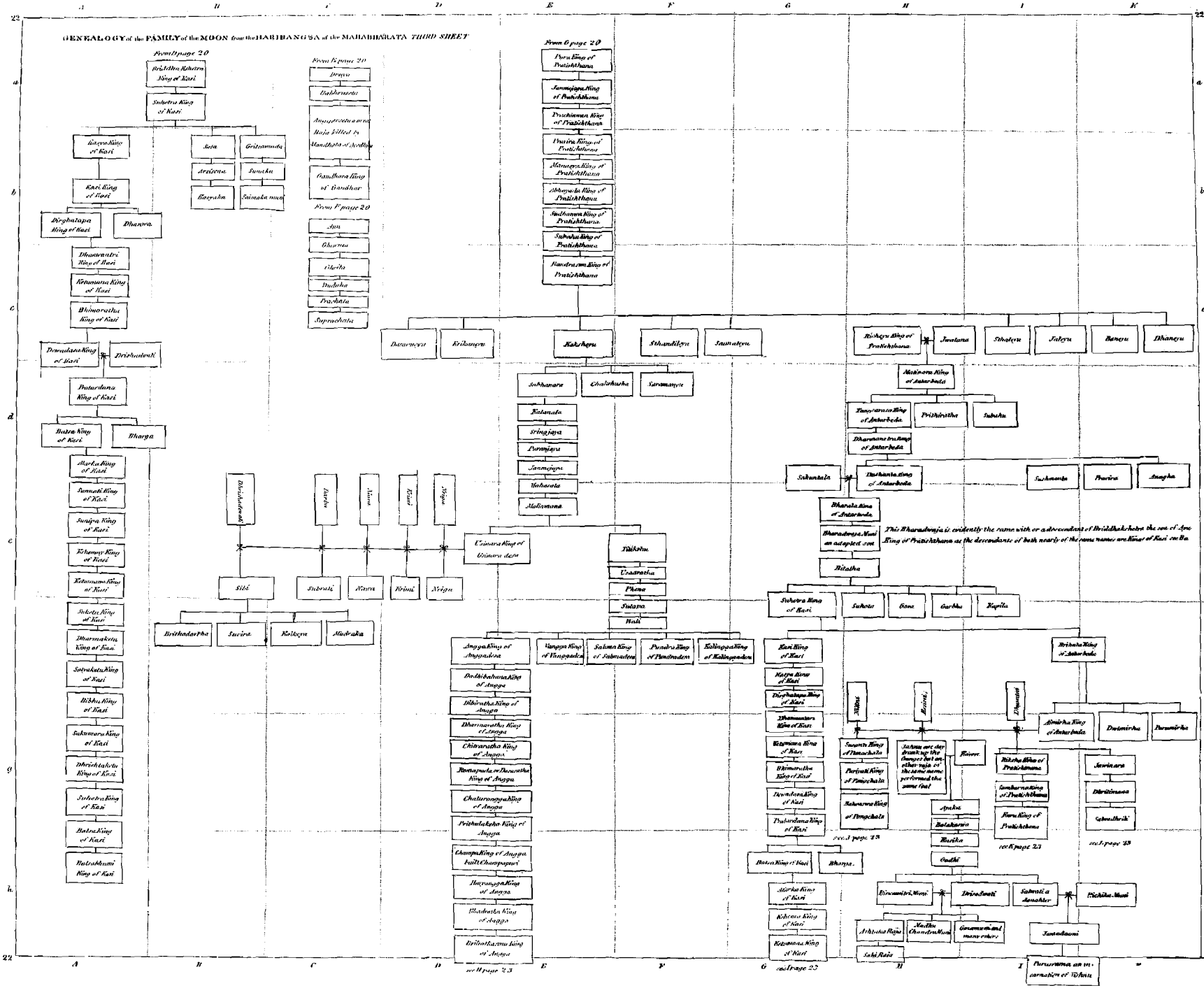
Pratyusha — Devalarishi

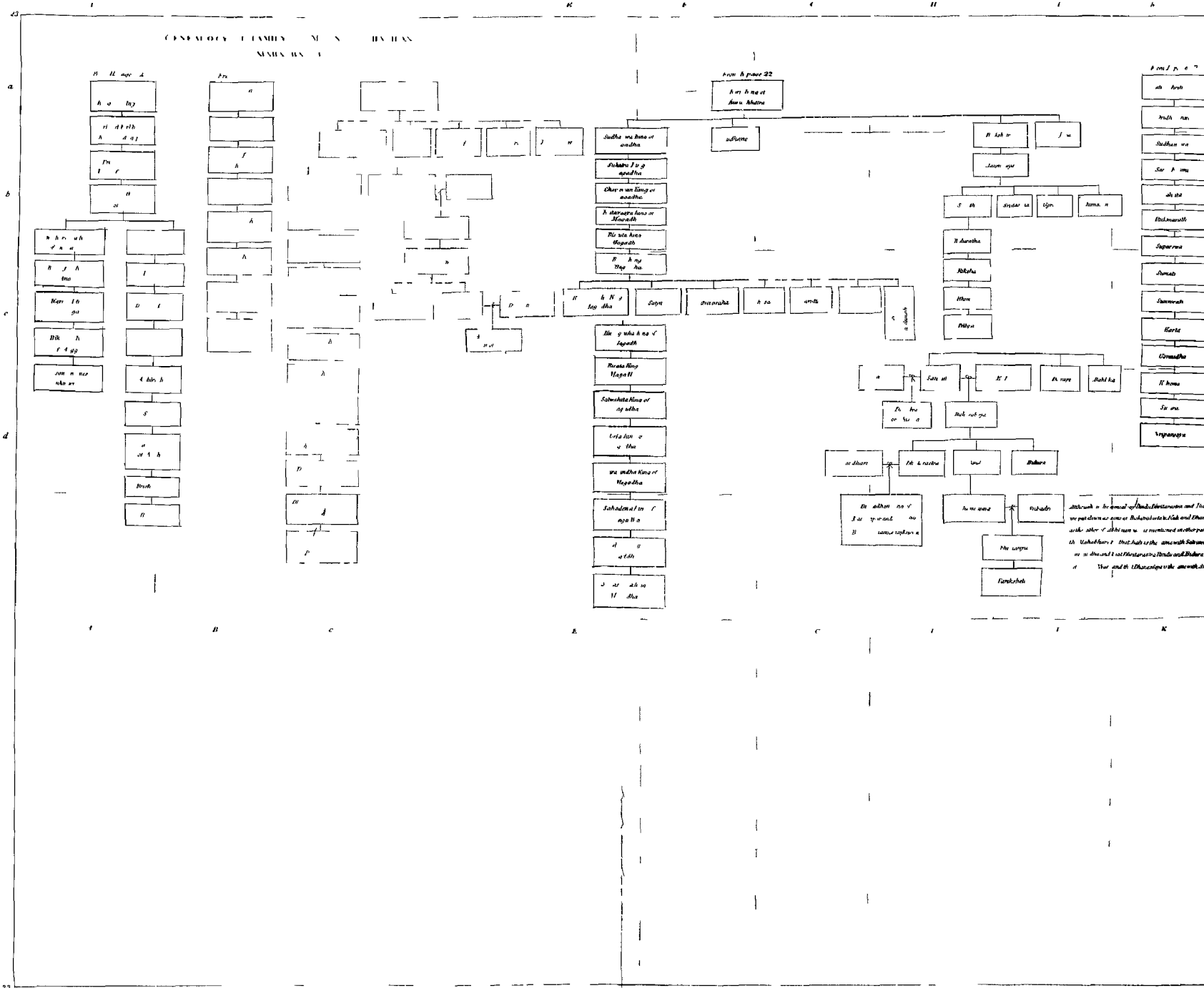
Prabha — Biswa Karma or Tvasta acharya.

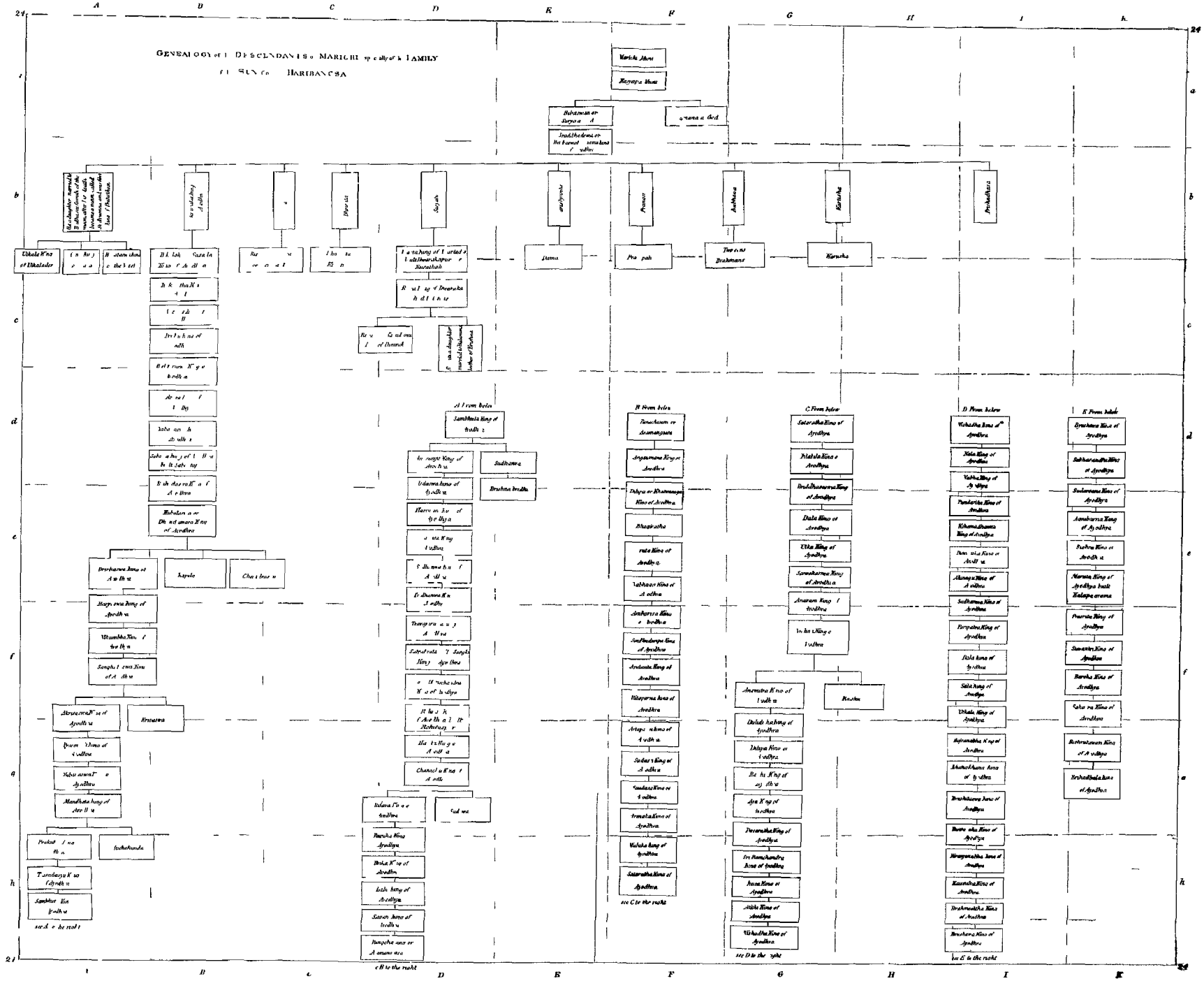

GENEALOGY of the FAMILY of the MOON as in HARIVANCSA of MAHABHARATA
Brahma
Atri
Soma God of the Moon King of the Brahmans descended from the eye of Atri
Budha born at the planet Mercury
Ila female of Vaivasvata or the son of the Sun
Purooravas Soma Pratishthana
Ayu was created by Brahma the root common to all the gods but his children were born when she was connected with Purooravas
Nahusha
Yati
Yayati
Puru
Yadu
Turvasu
Anu
Druhya
Anavara
Prahlhadhara
Sampata
Sagat
Bhaya
Krita
Marvalanta
Vahadeva
Nadi na
Jayatsena
Sanghata
Kshatradharman
Sahadeva
Sunaka
Kritanjaya
Ritayu
Akrodhana
Devatithi
Ruchiraswa
Ranteyu
Sumati
Dhrishtaketu
Haryaswa
Maruta
Pratindhara
Kritaratha
Devamidha
Vibudha
Mahadhriti
Kritiratha
Dhrishtakarman
Kritanjaya
Ranteyu
Sankritya
Gargeya
Shini
Satyaki
Yuyudhana
Asanga
Kshatradharman
Sunetra
Vitihotra
Bharga
Bhargabhumi
Dhurtta
Dhrita
Kritayu
Rabhasa
Navaratha
Anagha
Dirghatamas
Kakshivat
Oushija
Kaliyavana
Pradhishta
Suhotra
Gritsamada
Ajamidha
Kuru
Parikshit
Bhimasena
Nila
Dushmanta
Bharata
Suhotra
Hasti
Ajamidha
Riksha
Samvarana
Kuru
Parikshit
Janamejaya
Shrutasena
Ugrasena
Bhishma
Chitrangada
Vichitravirya
Kshetrajna
Pandu
Dhritarashtra
Vidura
Kunti
Madri
Yudhishthira
Bhima
Arjuna
Nakula
Sahadeva
Duryodhana
Duhshasana
Duhsaha
Duhshala
Abhimanyu
Parikshit
Janamejaya
Shatanika
Sahasranika
Asvamedhadatta
Adhisimakrishna
Nichakshu
Ushnin
Chitraratha
Shuchidratha
Vrishnimat
Sushena
Sunitha
Nripanjaya
Durvara
Timi
Bahadratha
Sukratu
Dhritimat
Vasu
Supratika
Sunaya


GENEALOGY of the FAMILY of the MOON as related in HARIVANCSA of the MAHABHARATA

GENEALOGY of the FAMILY of the MOON from the HARIVANGSA of the MAHABHARATA *THIRD SHEET*






GENEALOGY of the DESCENDANTS of MARICHI especially of the FAMILY of the SUN from HARIVAMSA
Marichi Kasyapa
Vivasvan or Surya
Sraddhadeva or Satyavrat Vaivasvata Manu of Ayodhya
Ila daughter married to Budha son of Soma and founder of the lunar race of kings
Ikshvaku
Nimi
Devaraja
Sagara
Angiras
Pramati
Arishtanemi
Kardama
Pulastya
Vikukshi Sasada
Nimi Janaka
Devarata
Sankriti
Guptachitya of Vaisali
Kusadhwaja
Dharmadhwaja
Kritadhwaja
Mitadhwaja
Khandikya
Kesidhwaja
Bhanumat
Satadyumna
Sucharu
Urdhwaketu
Anjana
Arishtanemi
Sagara
Asamanjas
Anshuman
Dilipa I
Bhagiratha
Sruta
Nabhaga
Ambarisha
Sahadeva
Virupaksha
Prithusravas
Ayutayus
Nalini
Nabhas
Pundarika
Kshemadhanwa
Devanika
Ahinagu
Paripatra
Dala
Chhala
Utthana
Vajranabha
Sankhana
Vyushitaswa
Viswasaha
Hiranyanabha
Pushya
Dhruvasandhi
Sudarsana
Agnivarna
Sighra
Maru
Prasusruka
Amsuman
Dilipa II
Bhagiratha
Sruta
Nabhaga
Ambarisha
Sindhudwipa
Ayutayus
Rituparna
Sarvakama
Sudasa
Mitrasaha
Asmaka
Mulaka
Dasaratha
Ilavila
Visvasaha
Khatwanga
Dirghabahu
Raghu
Aja
Dasaratha
Rama
Kusa
Atithi
Nishadha
Nala
Nabhas
Pundarika
Kshemadhanwa
Devanika
Ahinagu
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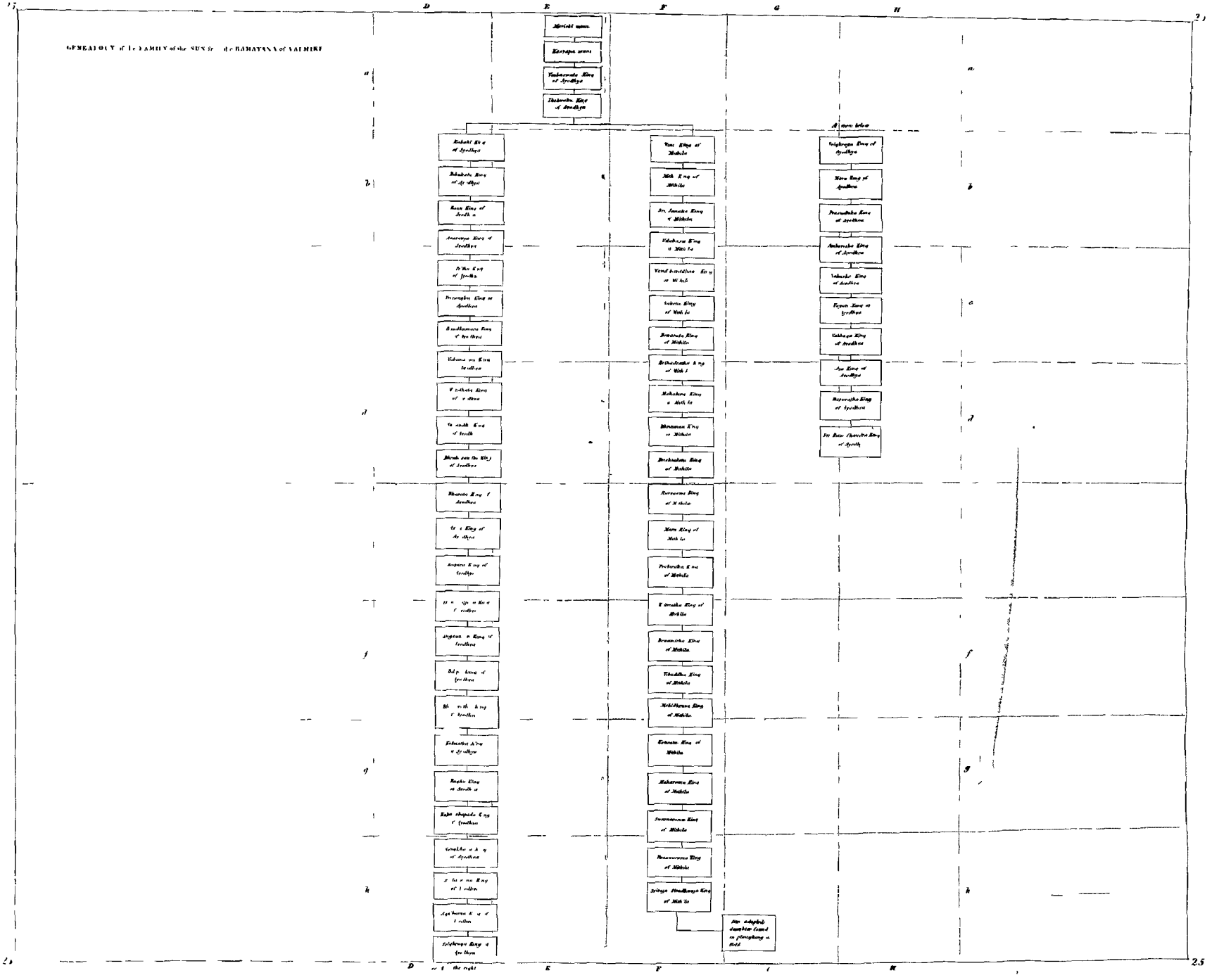
Asmaka
Mulaka
Dasaratha
Ilavila
Visvasaha
Khatwanga
Dirghabahu
Raghu
Aja
Dasaratha
Rama
Kusa
Atithi
Nishadha
see A to the right
see B to the right
see C to the right
see D to the right
see E to the right

GENEALOGY of the FAMILY of the SUN from the RAMAYANA of VALMIKI



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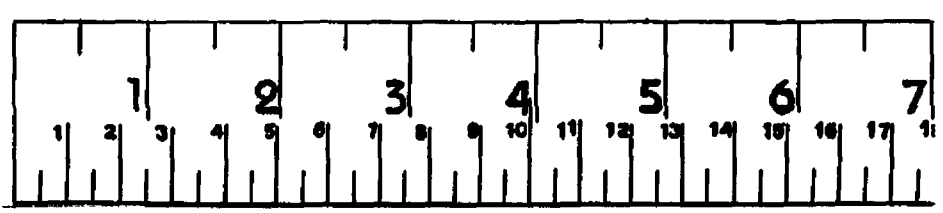
VOLUME 367.



Some Things in Geometry necessary to be learnt before Fortification

1. A Point is the smallest thing that can be conceived, is generally represented by a Point made with a Pen as A . A

2. A Line is length without any Breadth or Depth, & may be represented by a fine thread, hair or drawing of the Pen as BC B — C

3. The Ends of a Line are Points, & the shortest Distance between those Points is called a right Line

4. A Circular Line is every where equally Distant from a certain Point called the Center D, & the Point A being the center of each which Circular Line is also called an Arch of a Circle

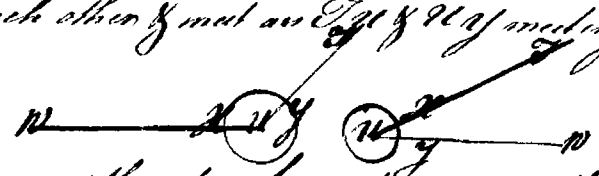
5. If a Circular Arch be continued quite round it is called the Circumference of a Circle as H I K L M whose Center is E

Every Circumference great or small is supposed to be divided into 360 Equal Divisions or Parts called Degrees, & each of those Degrees into 60 Equal Parts called Minutes, & each of those Minutes into 60 Equal Parts called Seconds &c.

7. A Line drawn thro' the Centre from one Side of the Circumference to the other is call'd the Diameter & half that Line the Same Diameter or Radius as BA which is the Diameter & BC or CA either of which is the Same Diameter or Radius

8. The Word Circle sometimes means the Number of Square Feet, Yards, Inches &c contain'd within the Circumference & sometimes it means the Circumference only when it is generally expressed Circumference of a Circle

9 If two Right Lines incline to each other & meet as Y & W do meeting in the Point W

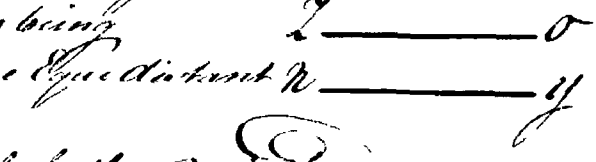


the Wideness or openess or Inclination of these two Lines to one another is called a Plain Angle

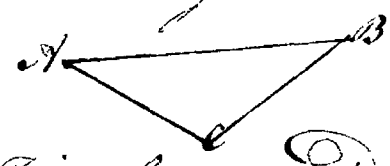
10 The Quantity of a Plain Angle is measured by supposing a Circle drawn round the Angular Point W as its Center & measuring from X to Y where the Circle cuts the two Lines & the Number of Degrees & Minutes contained in the Arch X Y is the Quantity of the Angle made by the Lines Y W & W X

11 An Angle is generally expressed by three Letters as Y W X the Middle most Letter as W representing the Angular Point

12 Parallel Right Lines are such as being in the same plain are everywhere Equi distant as Z O & R H

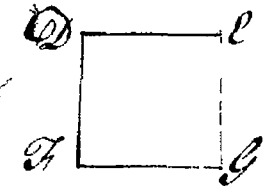


13 A plain Triangle is that which hath 3 Right Lined sides & three plain Angles as A B C

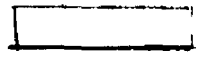


14 Each of the three sides of a plain Triangle is measured by a Scale of Yards Feet Inches Chains or some other equal Rule

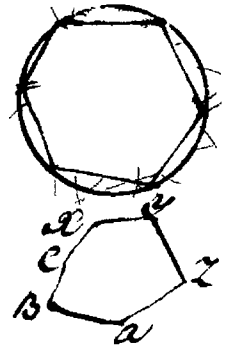
15 A Square hath 4 Right Lines sides & 4 Equal Angles each of which is 90 Degrees or a Right Angle



16 An Oblong hath 4 sides & 4 Angles the opposite sides being Equal & Parallel & the opposite Angles Right



17 A Figure of more than 4 sides is called a Polygon if its sides & Angles are Equal it is called a regular Polygon if unequal an irregular Polygon thus P R T H M is a regular Polygon & X Y Z A B C is an irregular Polygon



18 A Parallelogram is an Oblong Square the opposite sides being parallel & the opposite Angles also Equal as M O N D

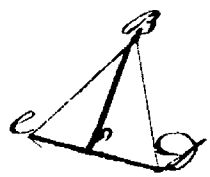
19 Every Regular Polygon stands within upon the Circumference of a Circle & each Side of such a Polygon is the Chord of as many Degrees of the Circle as it Cuts off

20 Therefore Divide 360. by the number of Sides of the regular Polygon & you have the Number of Degrees & Minutes each Side contains

21 A Five sided Polygon is call'd a Pentagon
A Six ..... a Hexagon
A Seven ..... a Heptagon
A Eight ..... a Octagon
A Nine ..... a Nonagon
A Ten ..... a Decagon
A Eleven ..... a Undecagon
A Twelve ..... a Duodecagon &c

22 If two sides of a Triangle are equal to each other as B C & B D it is call'd an Isosceles Triangle

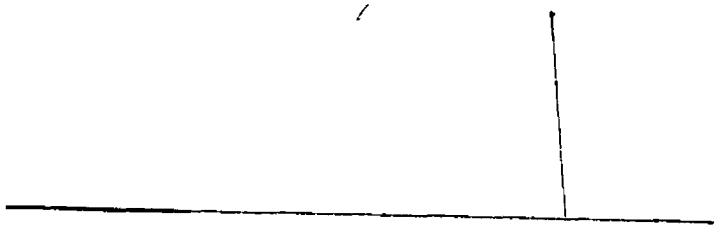
23 The Perpendicular of a Triangle is the shortest Right Line drawn from an Angular Point to the opposite Side as B C.



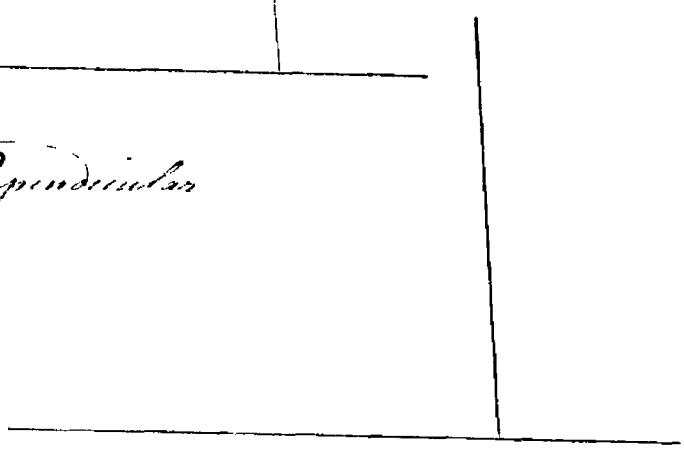
Geometrical Problems

1st To Draw a Line Parallel to another right Line given

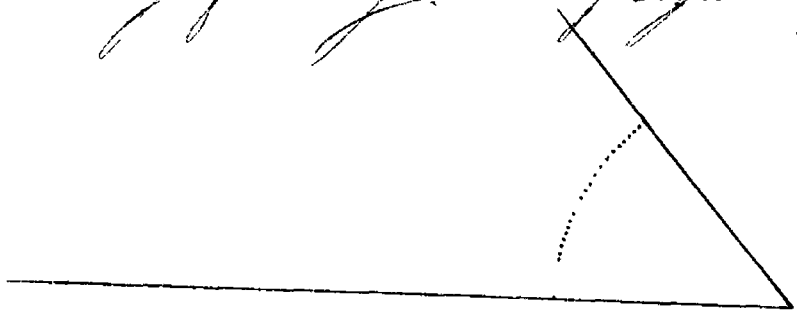
2 To Let fall a Perpendicular from any Point in a right Line given



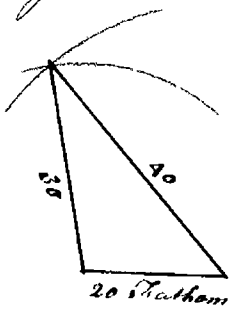
3 To let fall a Perpendicular



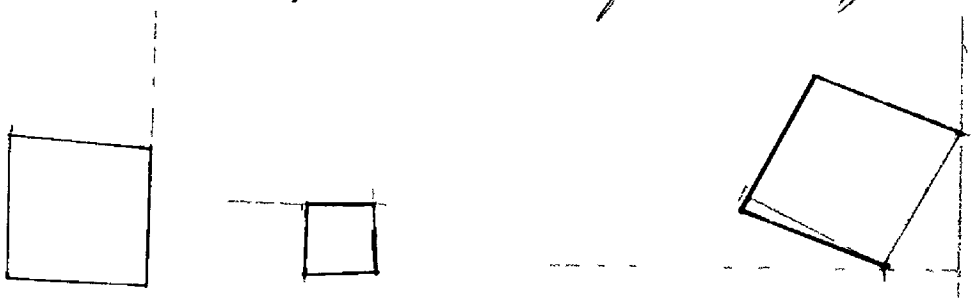
4 To make an Angle from any Number of Degrees Suppose 30



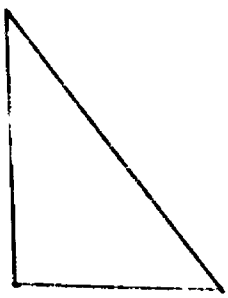
5 To make a Triangle whose three Sides are given



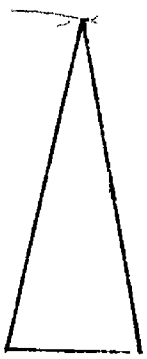
6 To make one Square equal to the Sides of two Squares given



7 To make a right Angle Triangle the two Shortest being given

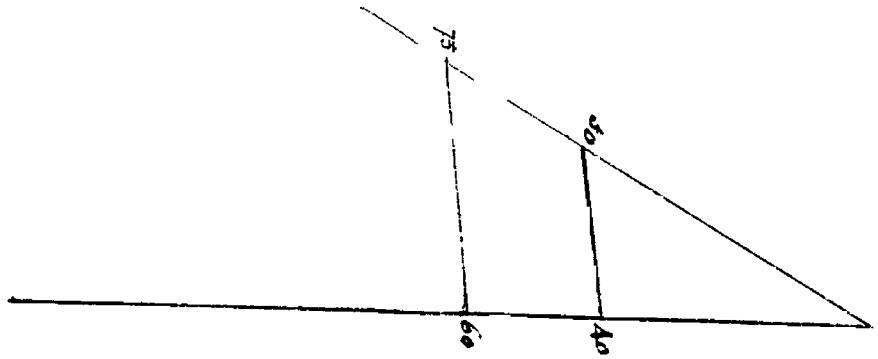


8 To make an Isosceles Triangle the two equal Sides & Base being Given

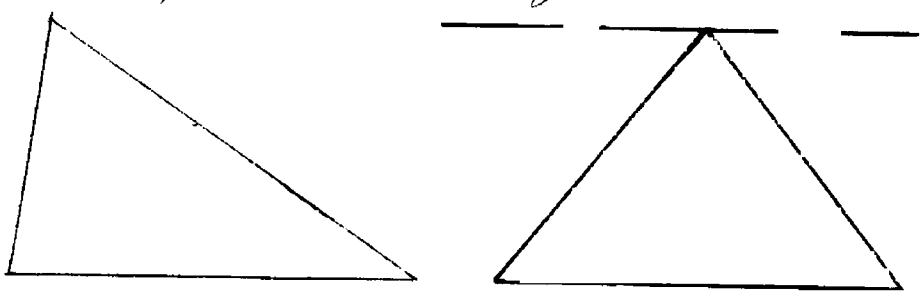


To work Proportion or the Rule of Three
Example

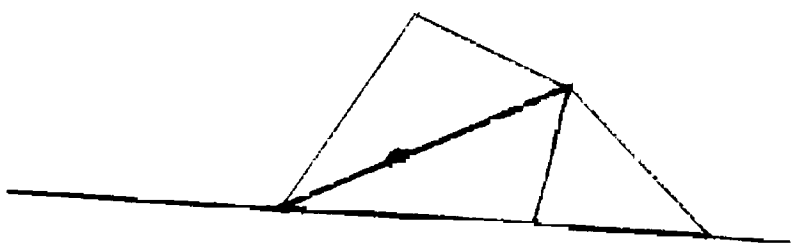
1 If 40 give 60 what will 50 give



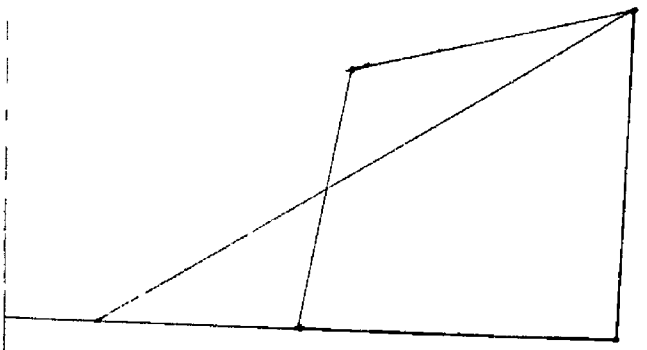
10 To reduce a Triangle into another Triangle equal thereto having the same Base & Perpendicular but Different Sides



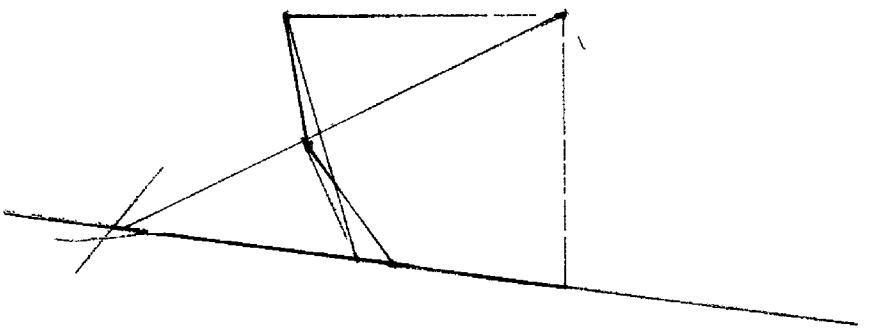
11 To Reduce a Trapezium or unequal four sided Figure into a Triangle



12 To reduce a Trapezium into a Triangle

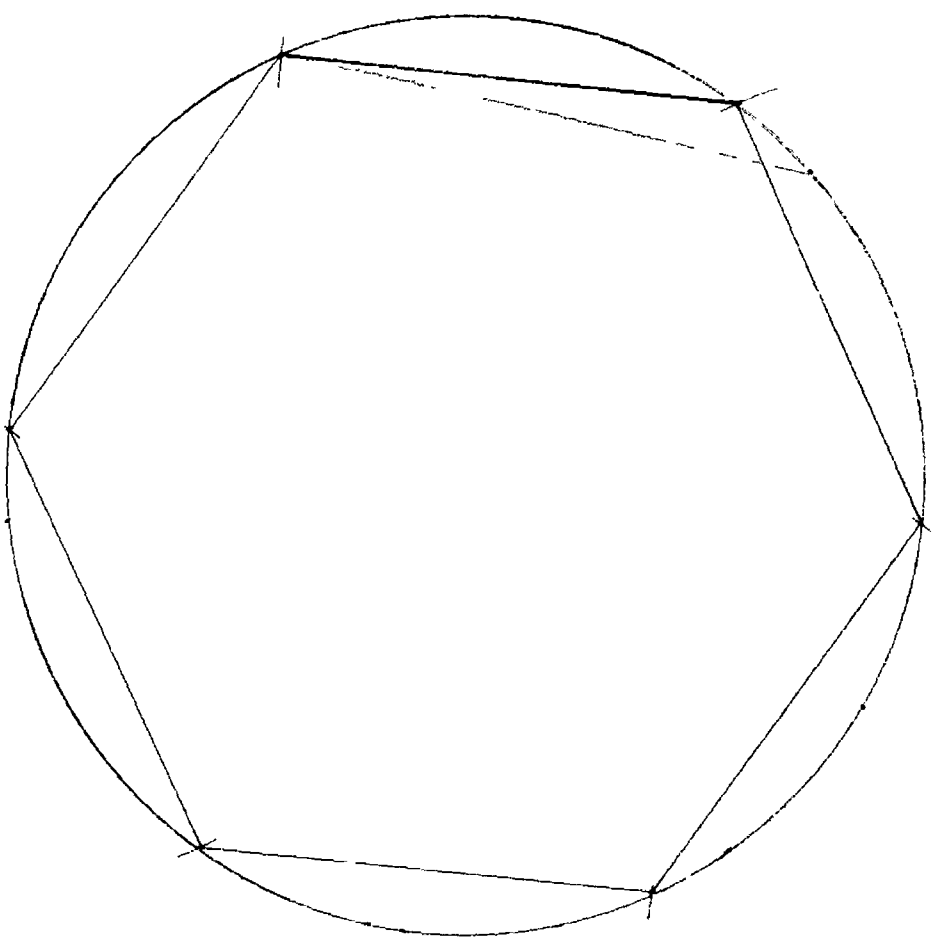


13 To Reduce a many sided Figure to a Triangle



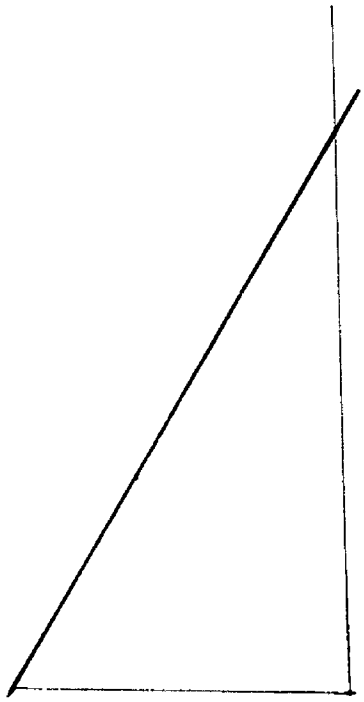
14. To Inscribe any Polygon in a Circle

Divide 360 by the Number of Sides of the Polygon the Quotient is the Arch of a Side



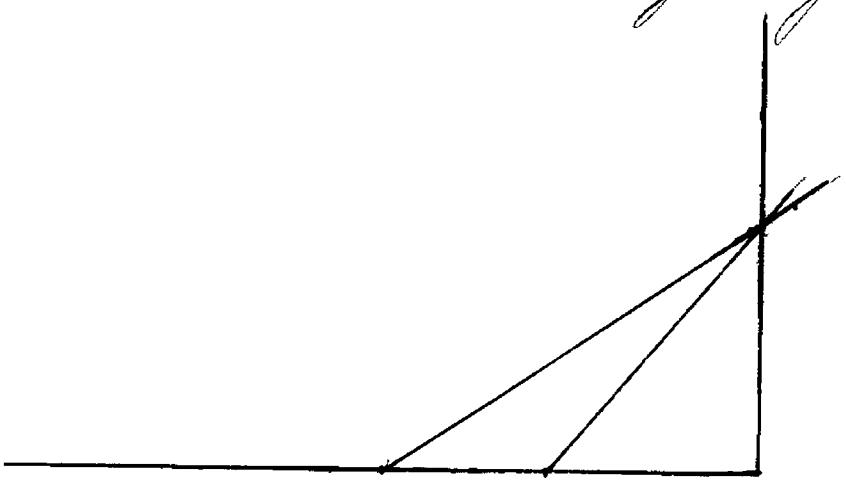
15 To find the Height of a Tower or Wall which is Inaccessible

Vertical Angle 60 Degrees
Distance 100 Yards

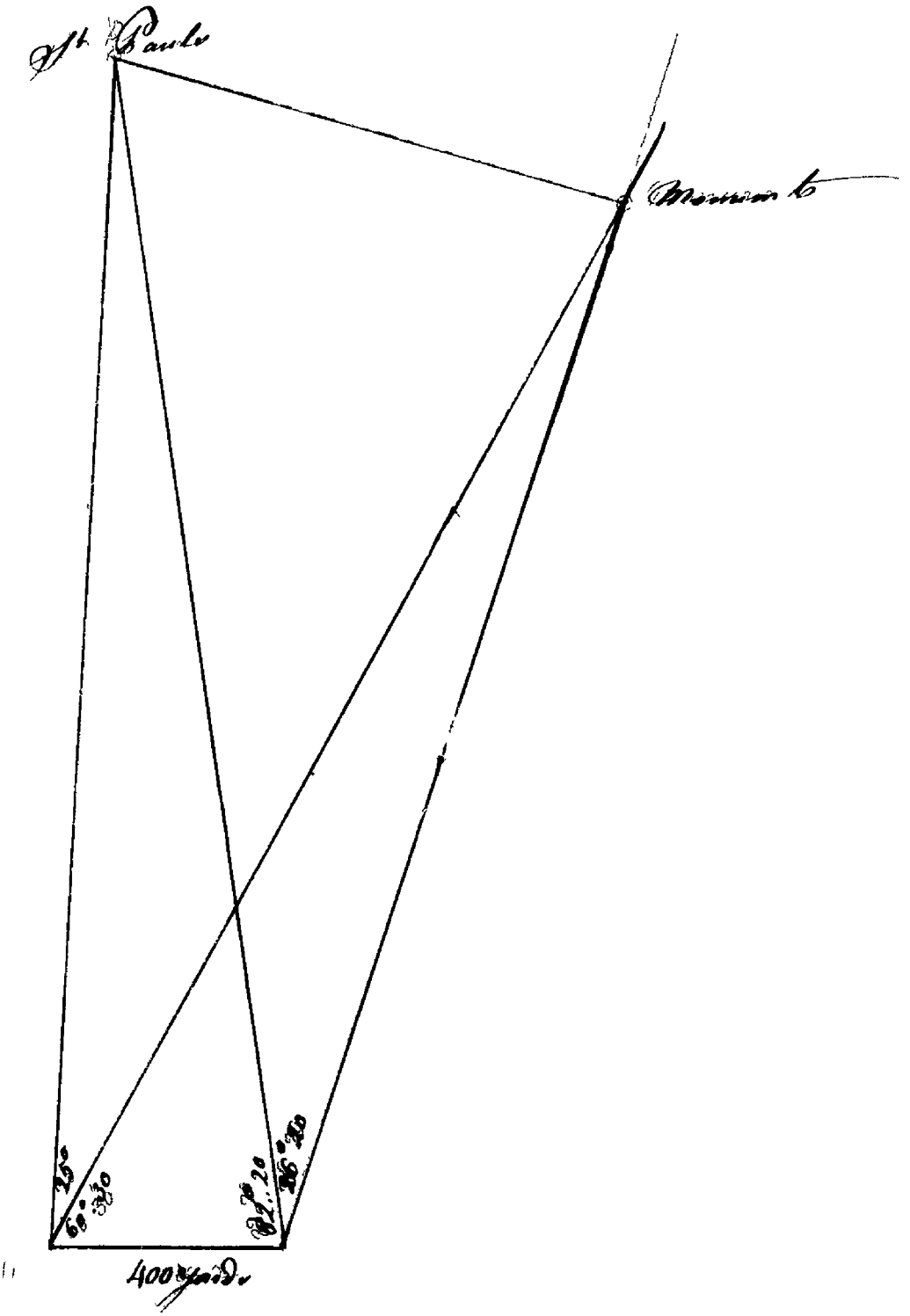


16 To find an Inaccessible Height by two Stations

first Altitude 35°
Second Altitude 50°
Stationary Line 50 Yards



Copy of an Instrument at Calcutta from St. Thomas. —



Superficial Mensuration.

Problem 1st

To Measure a Square having the Side given

Rule

Multiply the Side by itself the Product is the Area

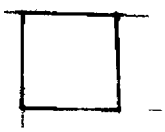
Example

If the Side of a Square Floor is 29.6 how many Square Feet are contained in the same

Operation

A 9

10 — 29.6
22.6
20 295.—
9 590.—
½ = ½ 26 5.6
14.9
Ans 870.8 Answ.



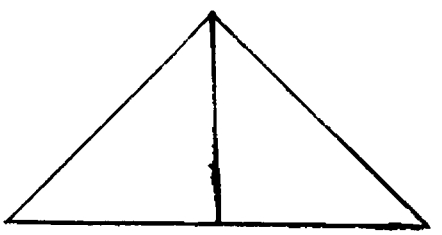
How many Square Yards are contained at the Top of a Square Tower one Side being 24.2 the other Side 24.2

10 24.2
24.2
20 486.2
4 493.1
½ 98.2
⅓ .8.—8
8.—8
608.1.4 Ans.

Example

The Base of a Triangular Plot is 125 Yds & its Perpendicular is 63 Feet

125
63
375
7500
÷ 2 | 7875
3937.½ Ans^r



Suppose the Above to be a Triangular Pavement paved at the Rate 1½ P^r Square Foot what will the whole amo^t to

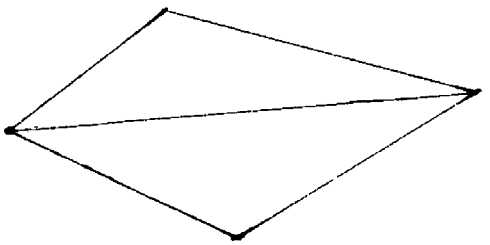
8 | 3937.½
10 | 492.5½
£23. 19. 5½ Ans^r

Problem 5

To Measure a Trapezium

Rule

Multiply the Sum of the 2 Perpendiculair by the Diagonal the Product is the Double Area



Problem 6

By the Diameter of a Circle to find the Circumference

Rule

Multiply the Diameter by 3.1459 the Product is the Circumference

Example

If the Diameter of a Bomb Shell be 13 Inches how much is its Circumference

3.1459
13
94377
31459
Ans. Inch 40.8967

Problem 7

Having the Circumference to find the Diameter

Rule

Divide the ~~Diameter~~ Circumference by 3.1459

Example

If the Circumference of a Round Bale be 30 Inches what is the Diameter

3.1459)30.0000(15.9/10 Inch
18541
28915

Problem 8th

By the Diameter & Circumference to find the Area

Rule

Or Multiply half the Diameter by half the Circumference the Product is the Area

Example

Diam 15.9 Circumference so required the Area

25
8
200 Square Inches Ans

Mensuration of Solids

1 Solid Mensuration is that whereby we Compute how many Solid Feet
yards &c are containd in any Solide Body whose Dimensions are given

2 In this kind of Geometry the Solid to be measurd is only found in a
Solid Body & sometimes perspectively expressd on a Plain

3 A Cube is a Solid which hath Six Equal Square Superficies & all its Angles
right

4th If the opposite Sides are Equal & Parallel & the Angles right the Figure
is Called a Parallelopipedon of which figure are Walls of Houses & sometimes
of Fortifications Rectangular Bricks & many others

5th If one End of a Parallelopipedon be shorter than the other it is Call'd a
Prismatic Solid

6th If the Solid be round at Bottom or Square or of any other Figure & Dimensions
ending in a Point at ye Top it is Called a Pyramid Viz a round Pyramid
Square Pentagonal Exagonal &c of which form are Spires of Churches &c &c

7th If such a Solid hath its upper Part cut off the Lower Part is Called the
Frustum of such a Pyramid Viz round Square &c of which Forms
are all Piers to be measurd & many other things

8th If the Figure of a Solid be the same at Bottom as at Top Viz round
Square Pentagonal &c it is Called a round &c Prism of such a form is
a Garden Rolling Stone the Admensuration of all which Figures from
their Dimension given is as follows

Example 1st

There is a Red Cistern of the form of a Cube its Length is 50 Inches Breadth
50 & Depth 50 how many Gallons will they Contain & how many Pounds
Weight of Water supposing a Pint a Pound

Rule

Multiply the Length Breadth & Depth together & Divide by the Proper Divisor

50
30
25 00

231) 12 5 000 (541. — . 1 Cub^m

. 9 50
. 260
. 29
116
2
236

G 2 0

541 — . 1

1
21 64
2
43 29 D^o of Water

G 2 0

Example

The Wall of a Fortification is 500 Long 10 High & 3 Thick how many Solid Yards are Contain'd in such a Wall & how Long will it be in Building at the Rate of 20 Solid Yards p^r Day

D^o 7^{D^o} 3^{D^o}

Rule

Multiply the Length Breadth & Depth together

500
10
5 000
3
20) 15 000 (Solid Yards in the Wall
700 Days

Example 2

A Trench is to be Dug in the form of a Parallelopipedon the Breadth is 5 fathoms Depth 3 fathoms & the Length 100 fathoms how many Men will dig such a Trench in 30 Days Supposing each of them to Dig a Solid Yard p^r Day

y^d
30
6
180
200
30) 36000 Solid Yards in the Trench
1200 . 0 each

H

Example 4

The Parapet of a Wall is 3 fathoms thick 1 fathom high & 20 fathoms Long without Embrasures how much will such a Parapet Cost in Building at 10 p^r Day a Solid fathom

6
2
12
40
480
2 240 each

Example 5th

How many Solid Feet of Timber are contained in a Square Beam whose Length is 25 feet Breadth 1 1/2 Depth Nine Inches

Feet
1/6 25. — —
1 2
25. — —
3/4 2
1/2 2 9. 2
9
1/2 14. 7
7 3 1/2
Ans. 21. 10 1/2

Example 6th

A Fosse is to be dug whose whose Depth is to be 4 fathoms the Breadth at Top 15 fathoms & Breadth at Bottom 7 fathoms & Length 50 fathoms how many Solid Yards of Earth will Compass such a Fosse

15
1/2 2 4
12
50
600 Solid fathoms
8
Ans. 4800 Solid yards

Example 7th

The Glacis of a Fortification is to be 20 fathoms Broad 1/2 high & 50 long how many solid Yards of Earth will raise such a Glacis

1 1/2
1/2 1 1/2
3/4
1/2 50
1/2 25
12 1/2
37 1/2
20
750 Solid fathoms
8
Ans. 6000 Solid yards

50
50
2500
231 | 125000 | 541.— 1 Cub
950
260
29
116
2
236

6 2 6 6 2 6
541.— 1
21641
2
43229 D W' of Water

Example

The Wall of a Fortification is 500 Long 10 High & 3 Thick how many Solid Yards are Contain'd in Such a Wall & how Long will it be in Building at the Rate of 20 Solid Yards p Day

Rule

Multiply the Length Breadth & Depth together

500
10
5000
3
20 | 15000 | Solid yards in the Wall
750 Days

Example 2

A Trench is to be Dug in the form of a Parallelopipedon the Breadth 18 fathoms Depth 3 fathoms & the Length 100 fathoms how many Men will dig such a Trench in 30 Days Supposing each of them to Dig a Solid Yard p Day

30
6
180
200
30 | 36000 | Solid yards in the Trench
1200 Men

Example 3

The Parapet of a Wall is 3 fathoms thick 1 fathom high & 20 fathoms Long without Embrasures how much will such a Parapet Cost in Building at 10 p Day Valid Stivers

6
2
12
40
480
240 Cost

Example 5.

How many Solid Feet of Timber are contained in a Square Beam whose Length be 25 feet Breadth 1 ½ & Depth nine Inches

Feet

$\frac{1}{6}$ 25. — — —

1 2

25. — 2

$\frac{1}{2}$ 12. 2

9

$\frac{1}{2}$ 14. 7

7" 3½

Ans. 21. 10½

Example 6

A Fosse is to be dug whose Depth is to be 4 fathoms the Breadth at Top 15 fathoms & Breadth at Bottom 9 fathoms & Length 50 fathoms how many Solid yards of Earth will Contain such a Fosse

15

$\frac{1}{2}$ 24

12

50

600 Solid fathoms

8

Ans. 4800 Solid yards

Example 7

The Glacis of a Fortification is to be 20 fathoms Broad 1½ high & 50 long how many solid yards of Earth will make such a Glacis

1½

$\frac{1}{2}$ 1½

3/4

50

$\frac{1}{2}$ 25

12 ½

37 ½

20

750 Solid fathoms

8

Ans. 6000 Solid yards

Example 8th

How many Cubick feet are contained in such a Pyramid

Rule

Multiply the Area of the Square by the Height & take one third of the Product for the Solidity

6
6
36
50
3 / 1800
600 Solid feet

Example 9th

How many Solid Inches are contained therein

3,1459) 30.0000 (9.5
16859
.112954

half Diam 4.75
ye Circum 15
2375
475
7125
10

1. Fortification or Military Architecture is that whereby Fortresses may be raised that a proper Number of Men within the Fortified may be able to defend it against a much greater Number without the Place

2 The Principles upon which this last depends are Geometry or the Doctrine of Angles, Lines, Superficies &c and the several Properties of Artillery or Great Guns

3 Fortification is either regular or irregular regular Fortification is that where the principal Parts of a Fortified Place are inscribed in a Polygon within a Circle & irregular Fortification is that where the several principal Parts are not inscribed in a Circle

4 In Fortification some of the works are immediately joined to the Place fortified & others are disjoined therefrom

5 Those parts near the Body of the place shd always be the strongest & able to defend the more outward Works when they are attacked & also sufficient & so situated as to recover any of the out works when they are lost & Contrarily

6 All the Outworks shd be so constructed as to afford the Besiegers the least Safety & Security & also the greatest Danger whilst they possess them

7 No Part of the Outworks shall be so constructed as to admit of the Besiegers passing them without the greatest Danger or as it is generally termed without Flanks

8 The Walls shd be of such a Height as but Just to look over each other & defend the other works with the adjacent Ditch

9 The several Ditches or Fosses shd be of such Depth & Breadth as to render their Passage very dangerous from the several works by which they are flanked

10 The Extra Ground Plot of every outwork shoúd be as narrow as possible & have a sufficient Number of flanks & Retrenchements on Ditches of their Lengths are such as to afford a Commencement to the Besiegers when taken

11 There are some of the principal Maxims which out to be observ'd in the fortifying of Places to which may be added that as the most simple Fortifications capable of answering their Ends are best & the Number of Men to defend a Place shoúd be always proportionable to the works themselves so the Advantages arising from the Defence of a Place shoúd be consulted before it be fortified

Notes

1 The Circle is drawn with the length of 180 Fathoms taken from the Scale of Equal Parts

2 The same 180 Fathoms goes Eleven round the Circle & forms the regular Hexagon.

3 Every one of the sides of the regular Polygon is devided into two equal Parts & a Line drawn thro that Point from the Centre call'd the Line of Centre

4 The Perpendicular is 23½ Fathoms which is drawn inwardly from the Middle of the side of the Polygon & hence the Lines of Defence are drawn

5 The Face of the Bastion is 50 Fathoms whence the Flanks & Curtains are form'd

6 The Breadth of the Parrapet is 3 Fathoms the Breadth of the Rampart 6 Fathoms & the Breadth of the inward Talus 3 4. or more or less Fathoms at pleasure the breadth of the Moat or Ditch next the Body of the place is from 12 to 15 Fathoms

Problem 10

Suppose the Diameter of the greater Base of the Frustum of a Round Pyramid or Cone to be 25 Feet & the Circumference of the upper End of the Frustum to be 40 Feet how many Solid Feet doe Contained in such a Frustum & the Length 30 Feet

Rule

Multiply the Area of the two Bases by each other & Extract the Square Root of the Product & this Root & the two Bases together & Multiply them Sum by the ⅓ Part of their Length

20.0000
3.1459
157295
78647.5
39.3237
12 o
471.8814
19.6623
7915167
127
3441082.67
98309.34
491546.7
62426.43 o 9. | 249.85
4

4 | 2241
4 | 176
409 | 4826
9 | 4401
4980 | 42543
0 | 39904
49965 | 253909
5 | 249825

3 1459) 10.0000 (12.71
.85410
221920
.17070
361 1/4

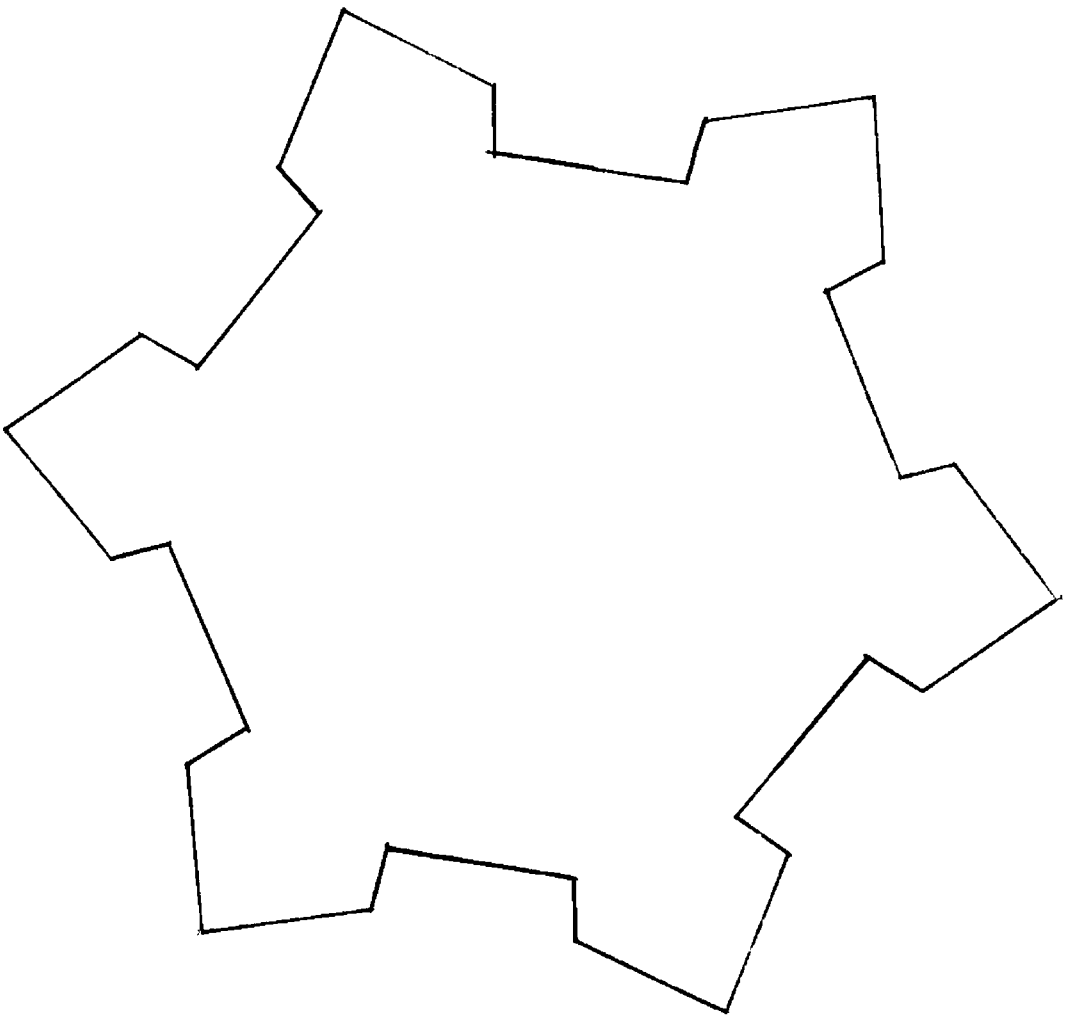
Root 249 85
great Base 491 55
Less 127 —
Sum 868.4
10
8684 — feet Solid the Answer

The Magistrical or Master Line of a Regular Hexagon

Note

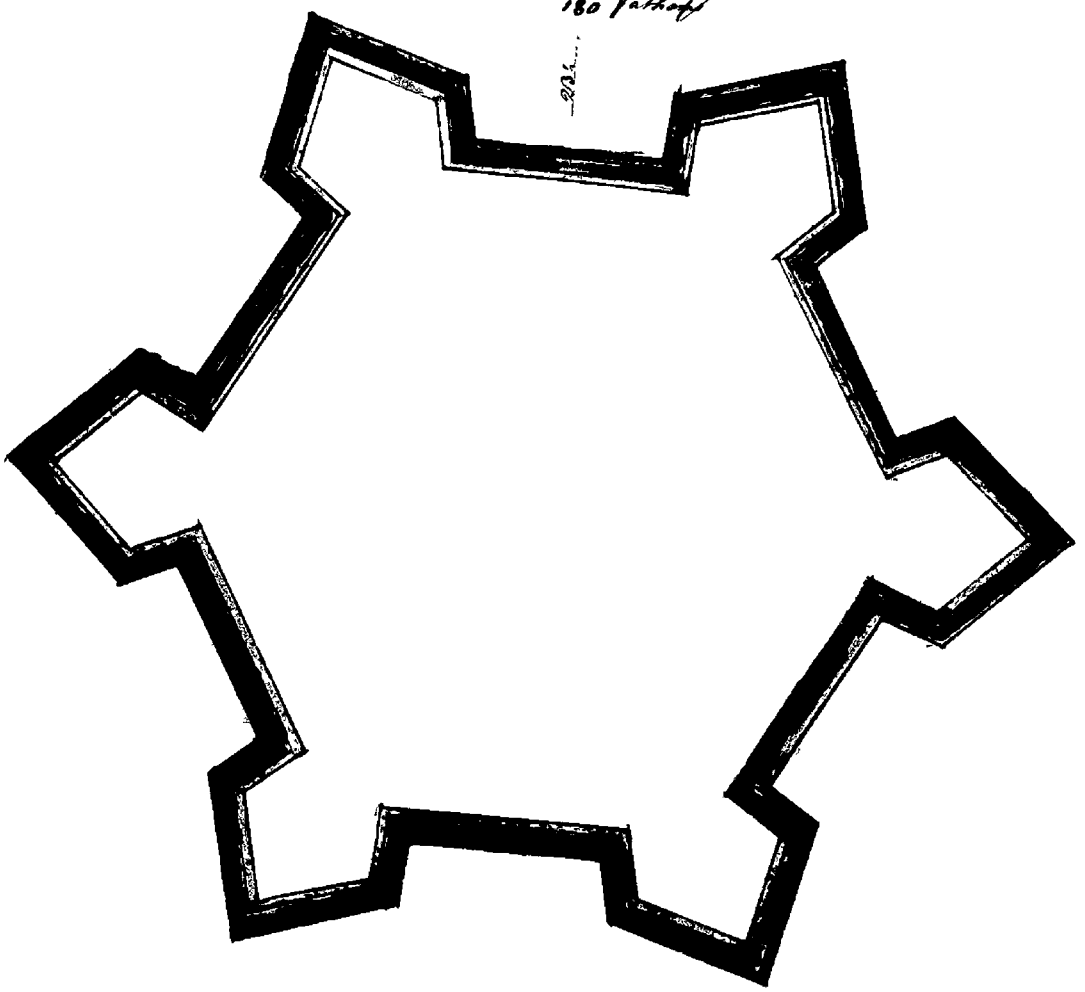
The Semi Diameter of Hexagon is 180 Fathoms
the Side of the Polygon — D.
the Perpendicular 23⅓ fathoms
the Base of the Bastion 60 fathoms

from which all the other Lines & Angles are found & Regulated



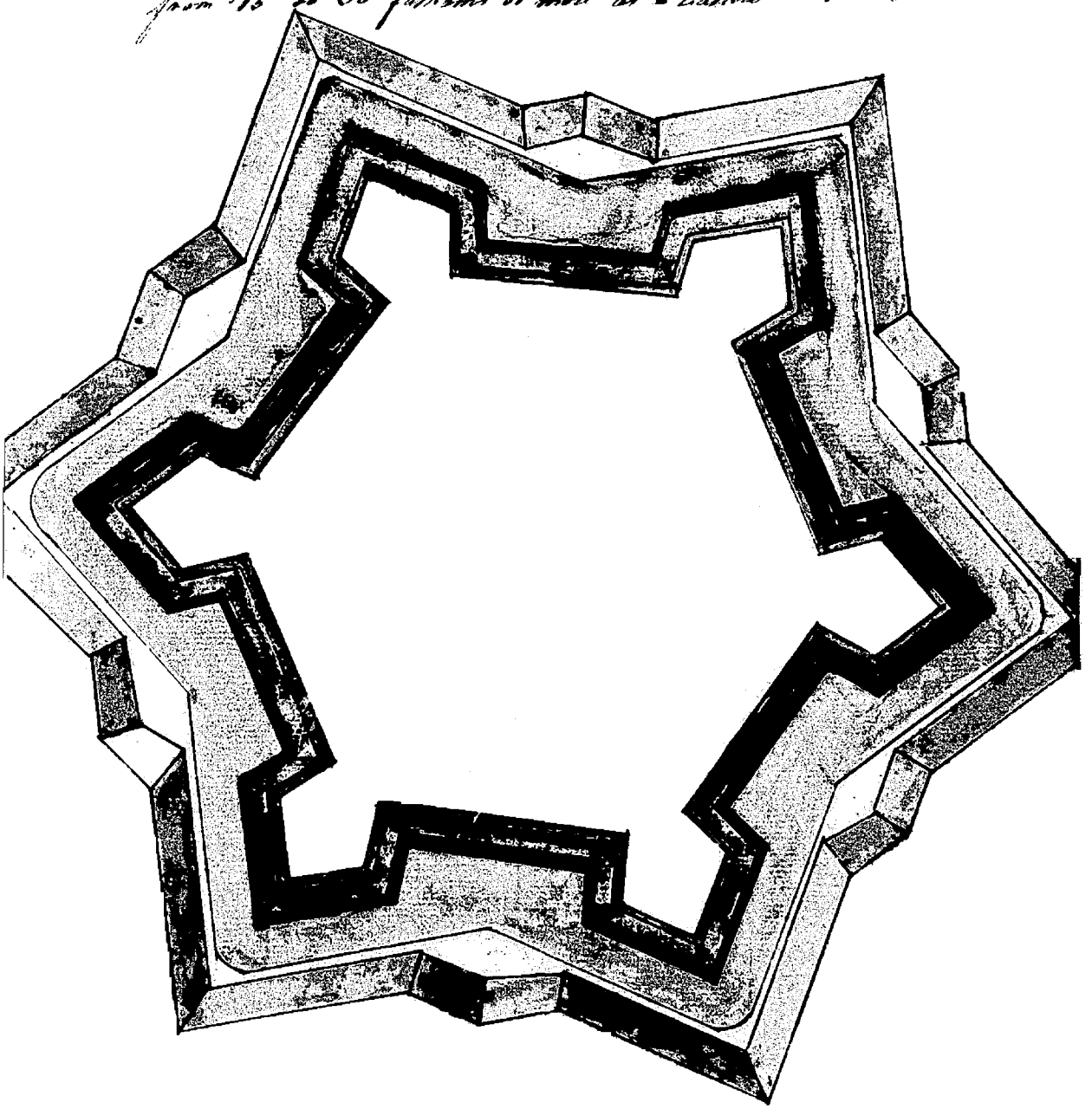
A Regular Hexagon with its Bastions Parapet Rampart & Talus

Note The Side of the Polygon is 180 Fathoms
the Perpendicular is 23½ Fathoms & Face of the Bastion 50 fathoms
the Parapet 3 fathoms thick. the Rampart 6 fathoms Broad & the Talus
3 fathoms thick at Bottom but may be made more or less at Pleasure)
they these all the other Sides are Regulated



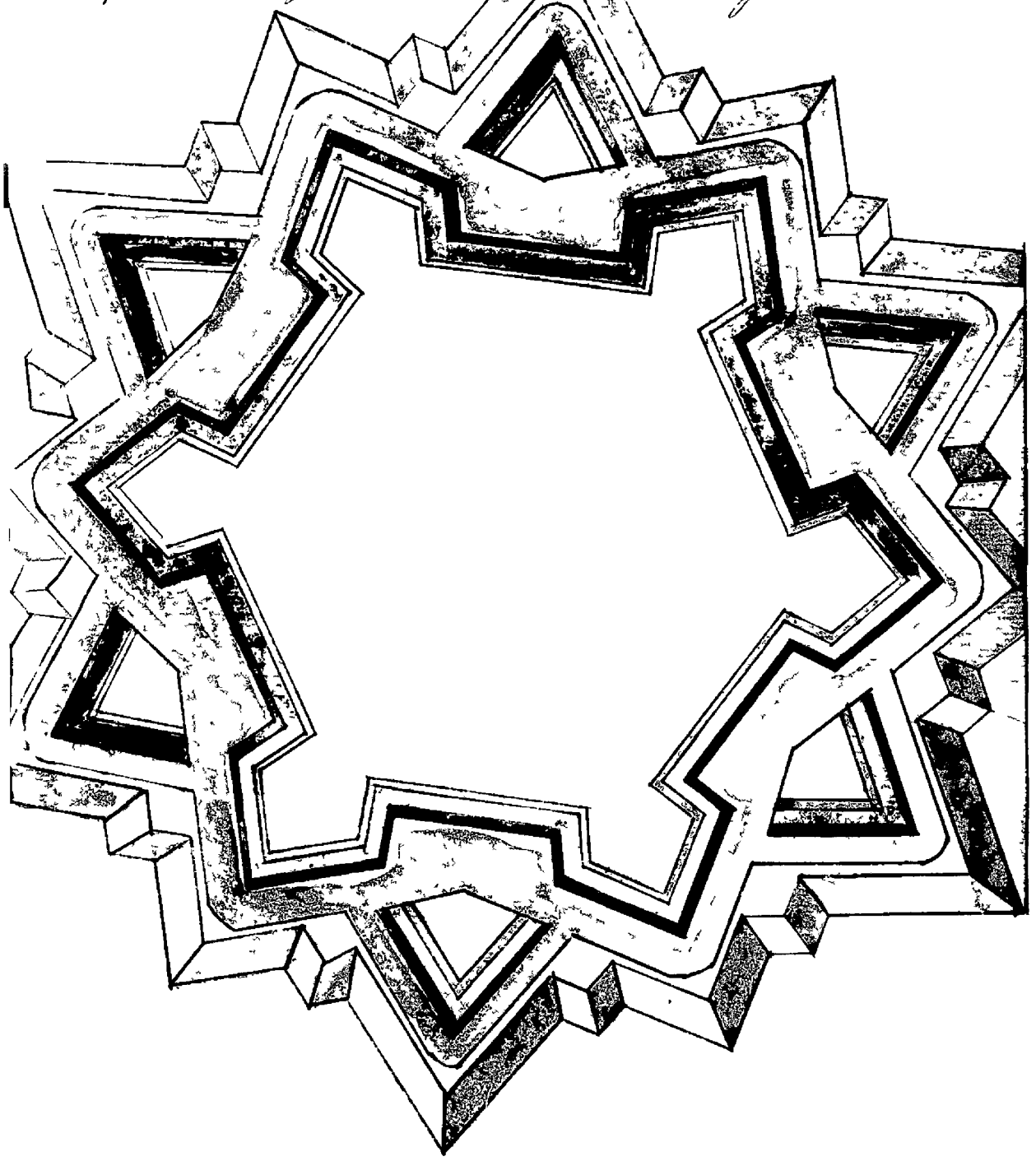
A Regular Hexagon fortified with its Bastions Fosse Covert Way & Glacis

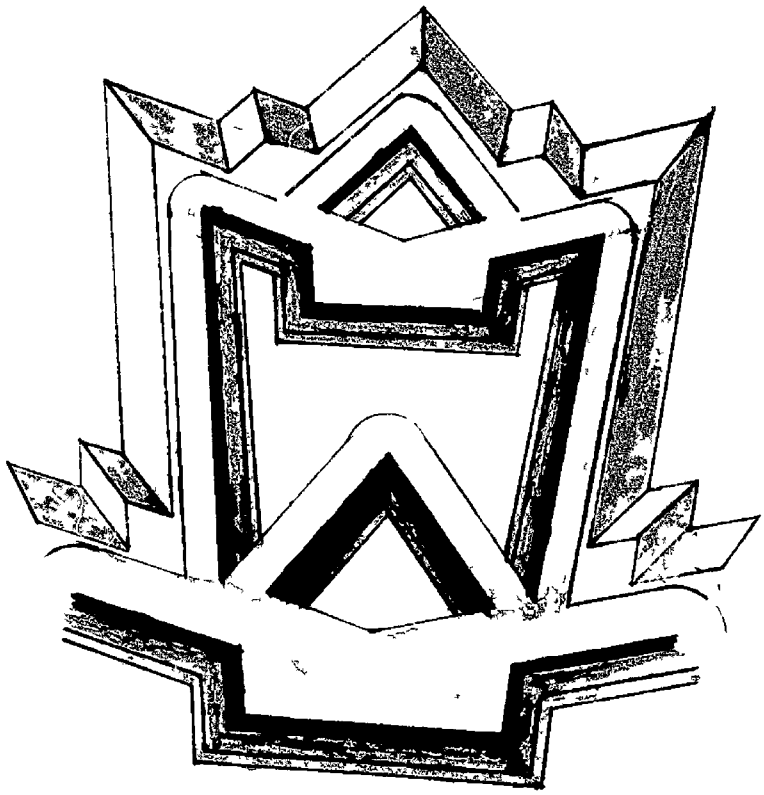
Note the Breadth of the Fosse before the Bastions is 15 fathoms the Breadth of the Covert way 3 fathoms the Counterfort Breadth of the Place of Arms from 10 to 12 fathoms the Breadth of the Glacis from 15 to 30 fathoms or more at Pleasure



A Hexagon fortified with the Rauelins before the Curtaines &c

Note the Capitol of the Rauelin before the Curtain is from 50 to 55 fathom
the Breadth of the Fosse before the Rauelin is 10 fathom
the face of the Rauelin makes the Shoulder of the Bastion by
from 2 to 5 fathom: the Rest as before

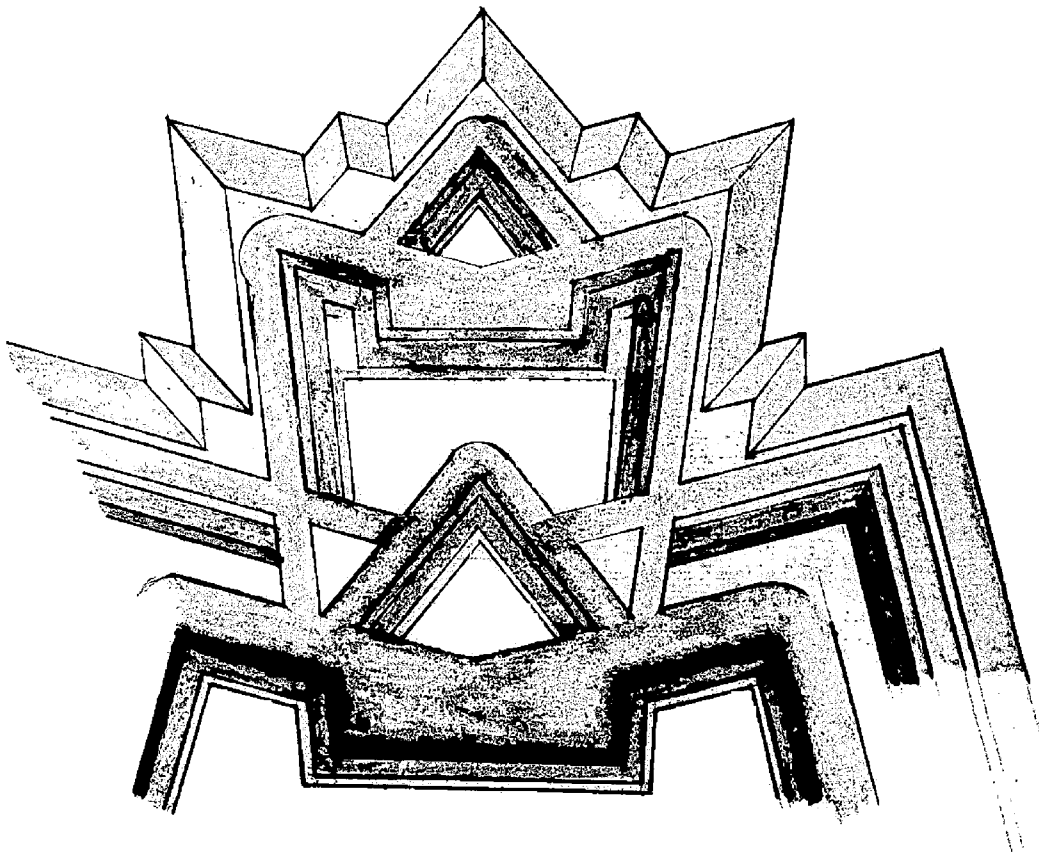




A Curtain & Bastions fortified with its Rawelin & Horn Work before the Curtain

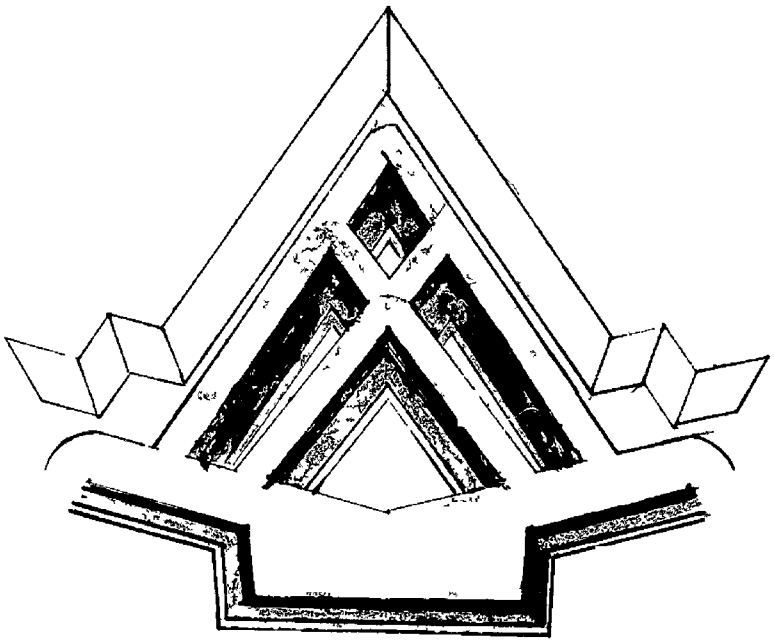
Note

The Capital of the Horn Work from the Counter scarp of the Rawelin in the Line of the Centre is 120 fathoms the Distance of the two Points of the Horn Work at Right Angles to the Line of the Centre is 120 fathoms the Perpendicular of the Horn Work is 2/3 of that of the Polygon the Fosse before the Horn Work is 10 fathoms & the Horn work Covers the Shoulders of the Bastion from 2 to 5 fathoms the Parapet Rampart & Talus of the Horn work may be from 2/3 to Equal to that of the Bastion & Curtain. the face of the Horn work is 2/3 of that of the Bastion the Capital of the Smale Rawelin before the Curtain of the Horn work is 2/3 of the Rawelin before the Curtain of the Polygon the Fosse before the Smale Rawelin 10 fathoms broad & the Covert of the Shoulder of the Horn work from 2 to 5 fathoms



A Horn work before the Curtain with half moons before the Bastions

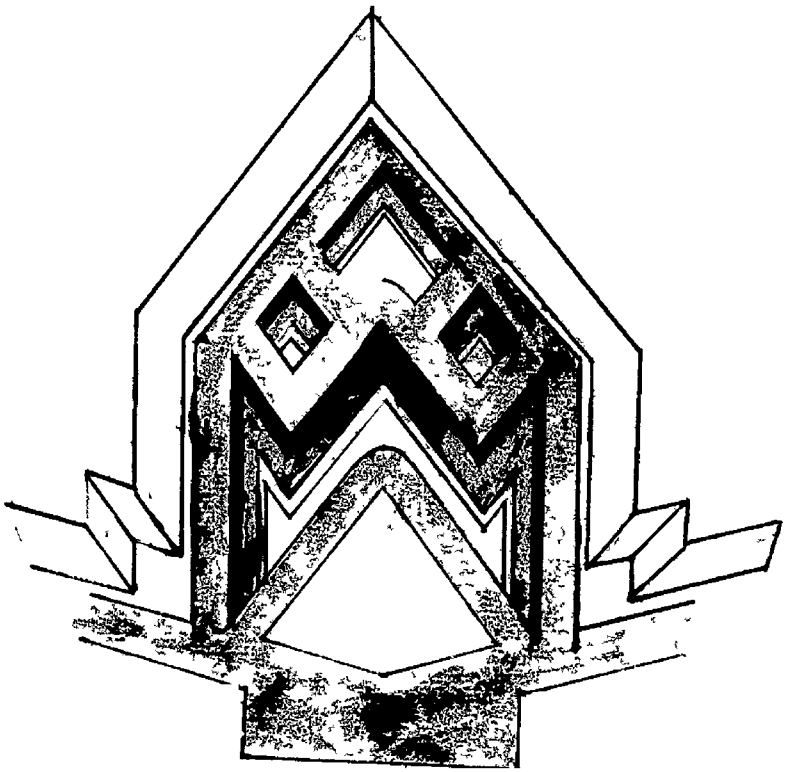
Note/ The Horn work is in all respects like the former but here the half Moons are flanked by the Rawlin the side of the Horn work being Between the Breadth of the Ground Plot of the half moons may be made at Pleasure from 8 to 12 fathoms Elevation of the Ramparts Parapet & Talus all other things as in the former



A Ravelin before the Curtain fortified with the Lunette

Note

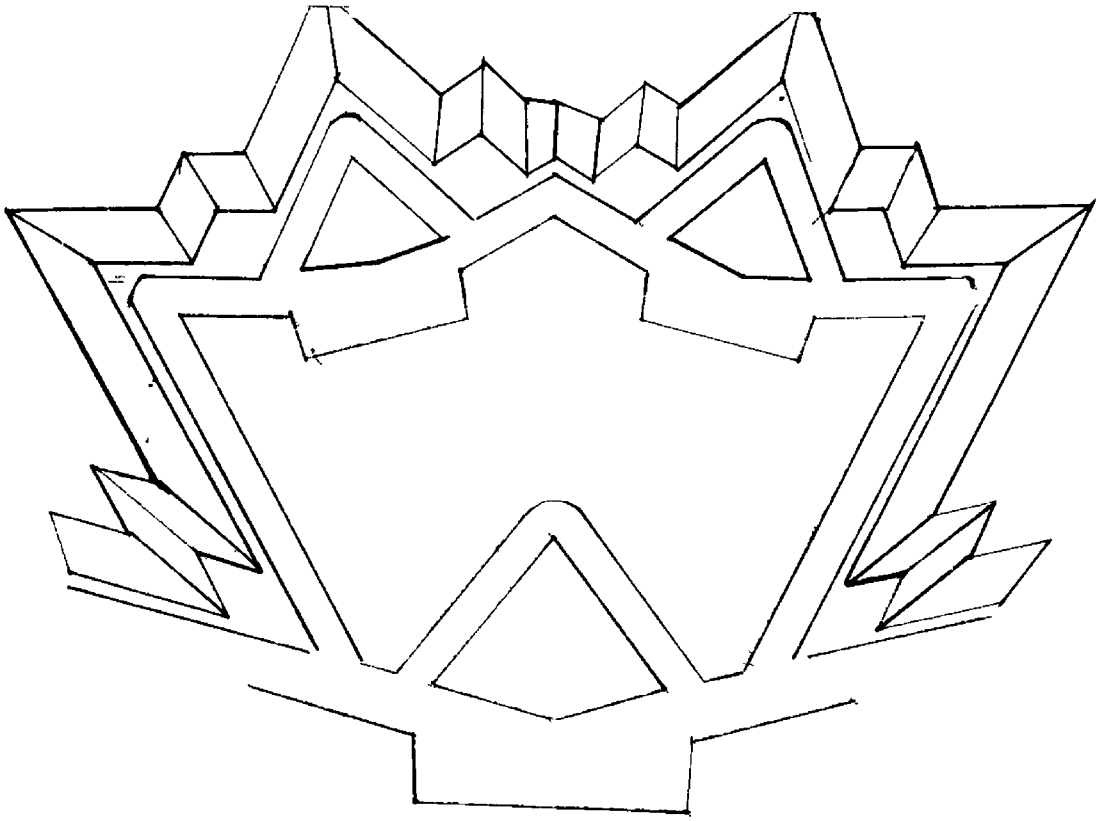
The Ground Plot of the Lunett may be made at Pleasure from 12 to 30 fathoms the face of the Lunett and the Small Ravelin may be from 15 to 30 fathoms the Breadth of the Ditches before the Lunette 15 feet. The Small Ravelin before the Lunettes may be made by the faces of the Lunette Provided to be flanked by the faces of the Bastions the Ditches in the the aforegoing



A Double Tenail before the Curtain & Rawlin with its Rawline

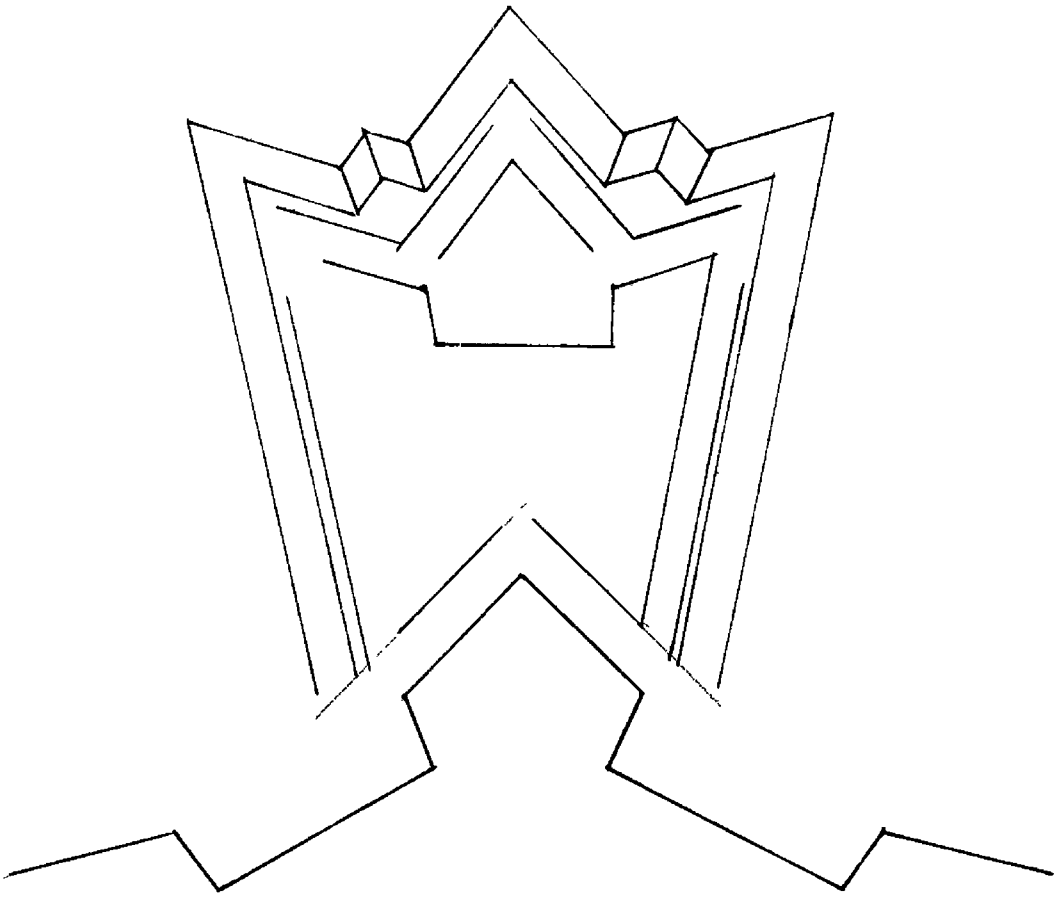
Note

The Capital of the double Tenail may be made at Pleasure from 80 to 120 Feet the double Tenail Cuts the Shoulders of the Bastion from 2 to 5 Feet the Sides of the double Tenail are parallel to the Capital of the Rawlin & the Inner faces of the double Tenail parallel to the Sides of the Rawlin the two flanking faces of the double Tenail may be made at Pleasure but best when ⅓ of the Inner faces Nearly a right Angle to them the small Rawline may be made at Pleasure Parallel to faces of the great Rawlin & Tenail



A Crown Work before a Curtain & Raulin with the Raulins &c

Note/ The Capitol of the Crown work is 150 fathoms the Capitol of the Bastion of the Crown work is 30 fathoms the Distance from the Point of the Bastion of the Crown work to the Stream Point of the Crown work is 120 fathoms the Perpendicular of each Curtain of the Crown work is 2/3 of that of the Bastion the Raulins before the Curtains of the Crown work & the Coverings of the Shoulders of the Bastions are the same as to the Horn works



Gunnery is that Part of Practical Mathematicks whereby any Piece of Ordnance may be so elevated as to hit a Mark at any Distance which is known

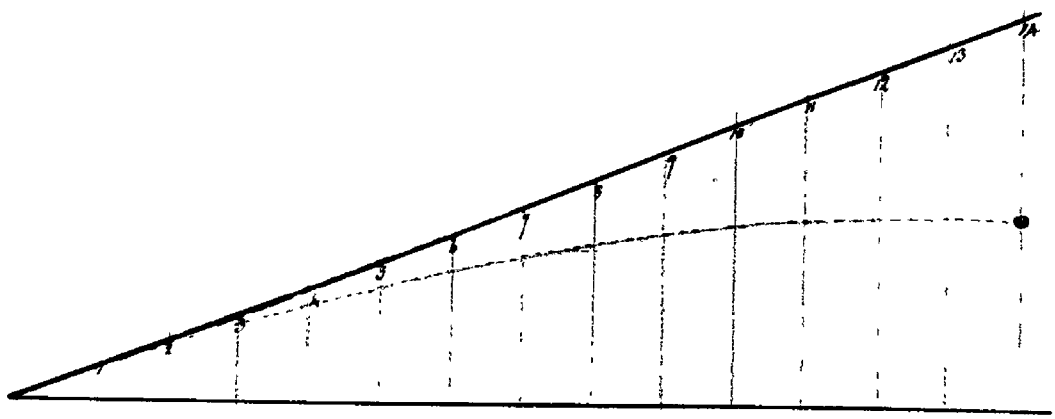
Def. 1. The Requisites to this Art are a Knowledge of the usual Quantity of Powder for Discharging the Piece of Ordnance the Place whereon the Ball or Shell is projected known the Distance & Situation of the Place to which it is to be projected & the Knowledge of the Balls Gravity towards the Earth whilst it is in motion together with the Resistance of the Air whereby it is considerably retarded & altered the Cause which it is otherwise made

Def. 2. The Forces of these Principles vary in all Projections whatsoever viz. Either with the Resistance of the Air in very considerable in small or light Shot but in heavy Balls of a considerable Diameter the Aire Resistance is so diminished as to become almost Insensible & therefore in such Cases is rejected

Def. 3. If a Ball be projected upwards or under any other Position its greatest Height in the one Case or greatest Distance on the other Case is usually called the Impetus or Force with which it is projected & that whereby the Velocity with which it is thrown from the Piece of Ordnance may be computed thus for Example——

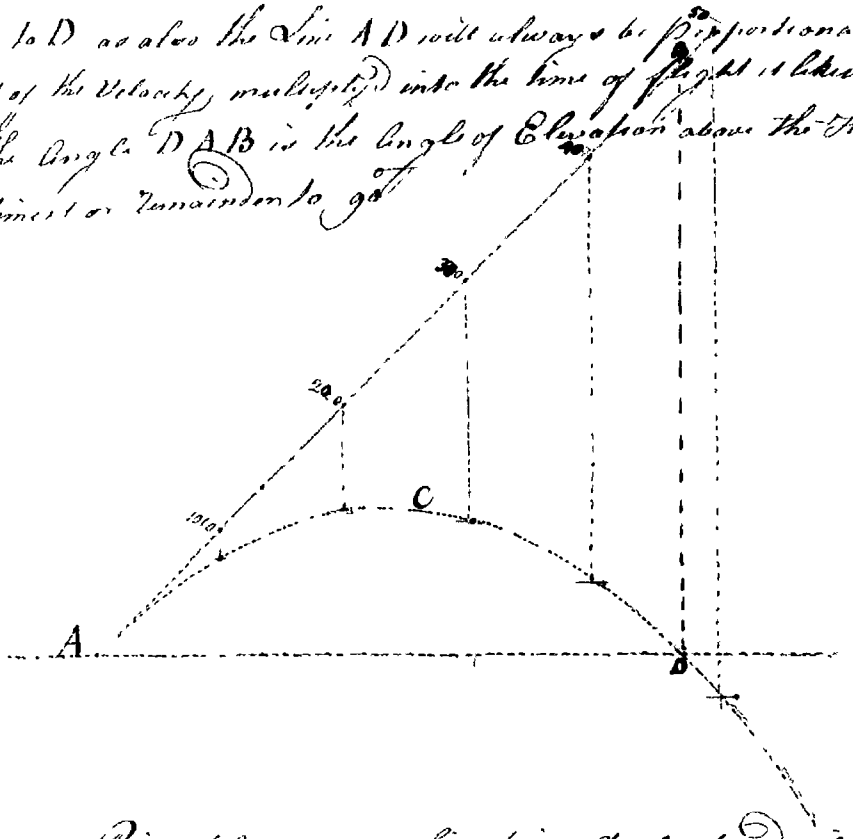
If a Ball be thrown upwards perpendicularly & observed to be 20 Seconds of time from the time it begins to descend to the time it falls to the Ground the Height of the Ascent will be equal to the Descent (that is to say) it will be 10 Seconds in mounting & 10 seconds in falling also because the Descent is proportional to the Square of the time a heavy Body descends 16 1/12 feet in a Second of time therefore 10 X 10 (= 100) X 16 1/12 = 1608 1/3 feet the Height of Ascent & 1608 1/3 feet the Depth of Descent to which the Ball moved & falls also Substract 1 Second of time from the Ascent or Descent & We have 9 Seconds of time from the Ball began to Descend to the End the last Exclusive of 1 Second of time 1st 9 X 9 X 16 1/12 = 1302 3/4 the 1st Descent of the Ball in 9 Seconds & 1608 1/3 Substracting 1302 3/4 = 305 1/12 the 1st Descent of the Ball the 10. Second of time being the Velocity with which the Ball is projected upwards from the Piece of Ordnance in the last Second of time & this Velocity is called the Velocity with which the Ball is projected from the Piece of Ordnance when it is Discharged under a given Position——

5th When the Piece of Ordnance is to be Discharg'd particular Regard is to be had to what Position it hath or ought to have above the Horizon & in order to deduct a Calculation the Ball is supposed to be pulled downwards perpendicularly towards the Earth whilst it is in Motion according to the Laws of Gravity aforementioned whilst otherways without Gravitation it would have proceeded in a right Line forwards equal Spaces in Equal Times with the Velocity it was projected from the Piece of Ordnance thus for Example

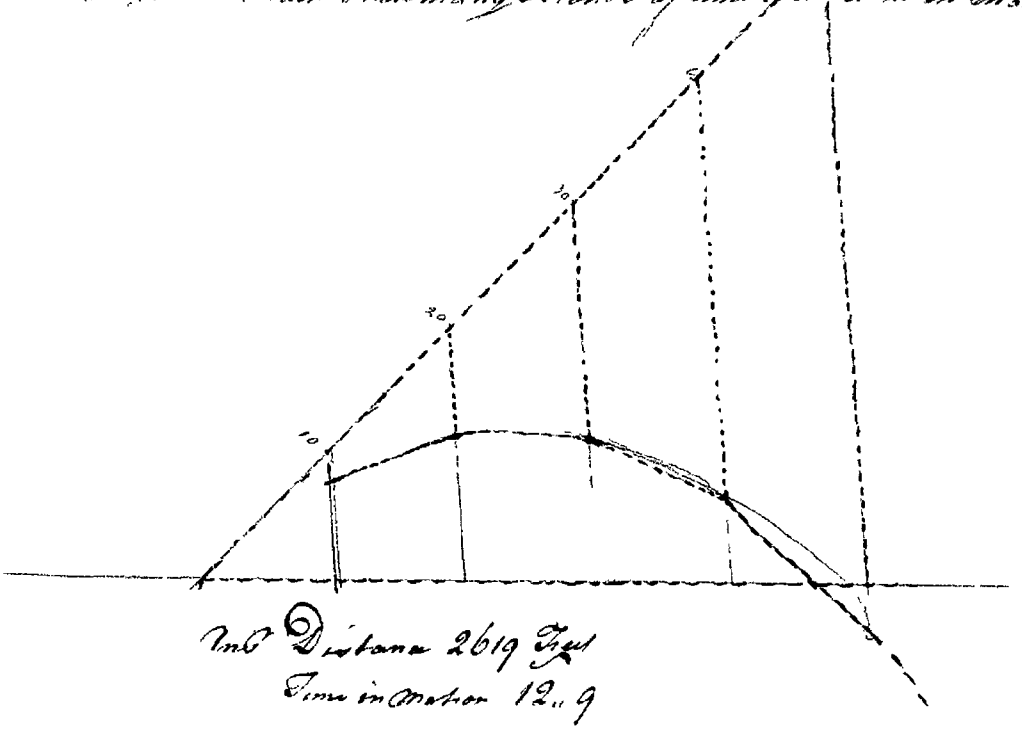


6th The Horizontal Range or Distance to which the Ball can be thrown over a Level Plain constitutes one Side or Base of a plain right angle Triangle the Line of Direction in which the Piece is elevated constitutes the other Side or Hypothenuse of the same Triangle & the third Side denotes how much the Ball is pulled down by Gravity to the Horizontal Plain from the Point where it was have arrived at by a uniform Motion in the Cathetus or Perpendicular of the same right Angled Triangle for Example Let A be the Piece of Ordnance A B the Line that we have been directed by a uniform Motion & any great Impetus also A C D the Trajectory A B D the Line which the Ball is pulled Down by during its flight by the Force of Gravity in this Case A D is the Horizontal Range & the Line B D will always be as proportional or Coparticipal to the Square of the time the Ball is in Motion

from A to D as also the Line AD will always be proportional to the Product of the Velocity multiplyed into the time of flight it likewise follows that the Angle DAB is the Angle of Elevation above the Horizon is Complement or remainder to 90°

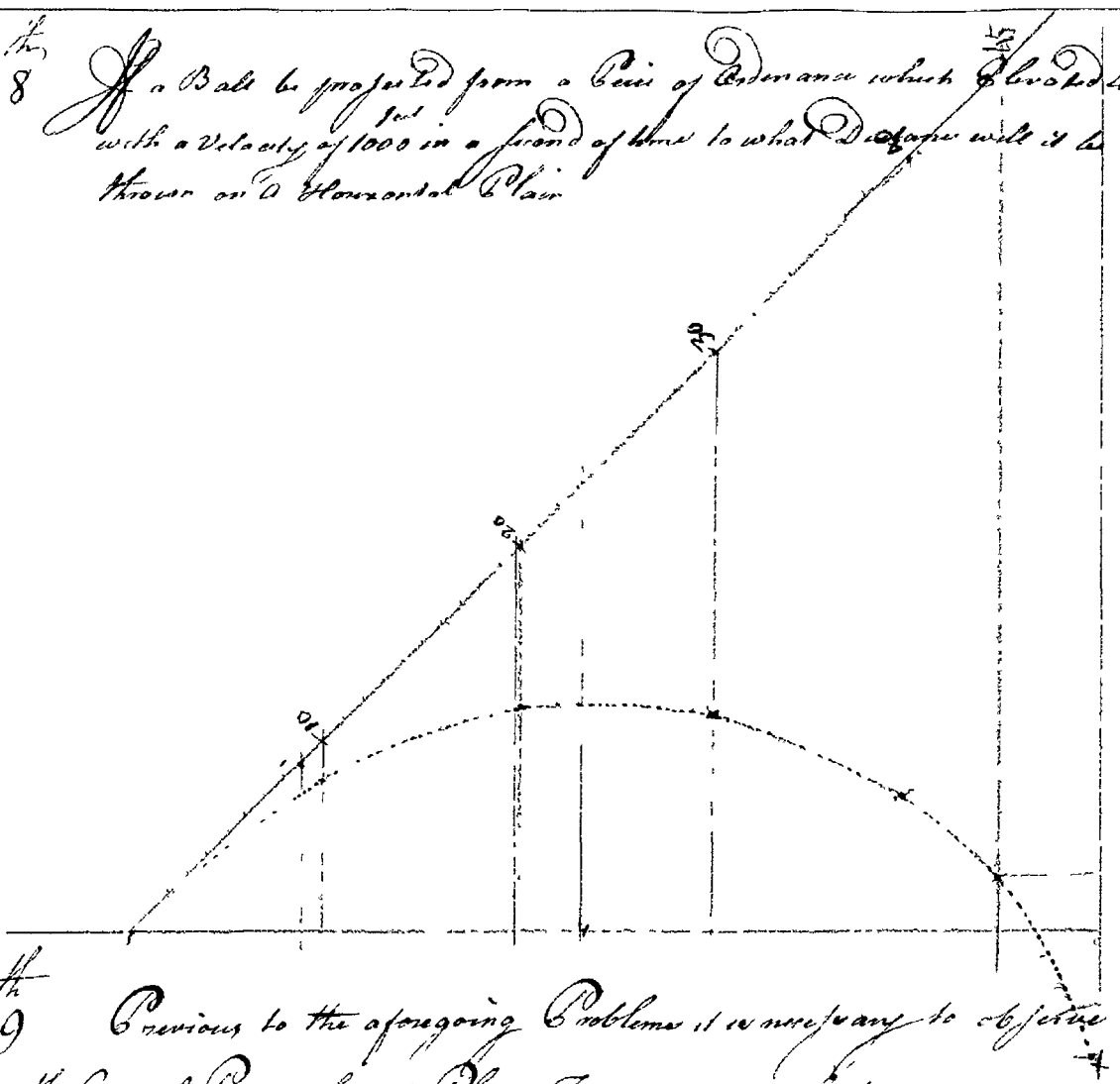


If there is a Piece of Ordinance which being Duely charged will throw a Ball to the Distance of a mile perpendicularly now if such a Piece of Ordnance be Elevated 45° above horizontal Distance will it throw the same Ball in a Horizontal Plain How many Seconds of time will it be in Motion



Ans Distance 2619 Feet
Time in Motion 12.9

8th If a Ball be projected from a Piece of Ordnance which Elevated 45°
with a Velocity of 1000 feet in a Second of time to what Distance will it be
Thrown on a Horizontal Plain



9th Previous to the aforegoing Problems it is necessary to observe
the General Principles of Plain Trigonometry which are as follows

No 1. The Sines of the Angles of all plain Triangles are Directly
Proportional to their opposite Sides

2 The Square of the Hypothenuse of a right Angle plain Triangle
is equal to the Sum of the Square of its two Shorter Sides

3 As the Sum of two Sides of a plain Triangle is to their Difference
So is the Tangent of the half Sum of the two opposite Angles to
to the Tangent of half their Difference

4th As the Base or Longest Side of a Plain Triangle is to the Sum of the two other Sides so is the Difference of those two other Sides to the Difference of the Segments of the Base The Particular Use & Application of all which Rules will be shewn as they occur in their order

But before the application of Plain Trigonometry to Gunnery it is necessary for facilitating the Operations in the Several Cases that we have ready at hand the following Table

6 Table shewing the Distance of a heavy Body in Vacuo for any time from one Second of Time to 1000 Seconds applicable also for finding the Distance of Bodies to Tenths & Hundredths of a Second of time & Contra

Tabeo

Anzahl der Jahre	Duecaten in Gold	Drittel	Anzahl der Jahre	Duecaten in Gold	Drittel	Anzahl der Jahre	Duecaten in Gold	Drittel	Anzahl der Jahre	Duecaten in Gold	Drittel
1	16.	08	46	34032.	33	89	127396	08			
2	64.	33	47	35328.	08	90	130275	00			
3	144	75	48	37056.	00	91	133186	08			
4	257.	33	49	38616.	08	92	136129	33			
5	402	08	50	40208.	33	93	139104	75			
6	579.	00	51	41832.	75	94	142112	33			
7	788	08	52	43489.	33	95	145152	08			
8	1029	33	53	45178.	00	96	148224	00			
9	1302	75	54	46899.	00	97	151328	08			
10	1608	33	55	48652.	08	98	154464	33			
11	1946	08	56	50437.	33	99	157632	75			
12	2316	00	57	52254.	75	100	160833	33			
13	2718	09	58	54104.	33	101	164066	08			
14	3152	33	59	55986.	08	102	167331	00			
15	3618	75	60	57900.	00	103	170628	08			
16	4117	33	61	59846.	08	104	173957	33			
17	4648	08	62	61824	33	105	177318	75			
18	5211	00	63	63834	75	106	180712	33			
19	5806	08	64	65877	33	107	184129	33			
20	6433	33	65	67952	08	108	187596	00			
21	7092	75	66	70059	00	109	191186	08			
22	7784	33	67	72198	06	110	194808	33			
23	8508	08	68	74367	33	111	198162	75			
24	9264	00	69	76572	75	112	201749	33			
25	10052	08	70	78808	33	113	205370	08			
26	10872	33	71	81076		114	209024	00			
27	11724	75	72	83376	00	115	212762	08			
28	12609	33	73	85708	08	116	216478	33			
29	13526	08	74	88072	33	117	220164	75			
30	14475	00	75	90468	75	118	223944	33			
31	15456	08	76	93897	33	119	227756	08			
32	16469	33	77	95663		120	231600	00			
33	17514	75	78	97851	00	121	235486	08			
34	18592	33	79	100376	08	122	239384	33			
35	19702	08	80	102933	33	123	243324	75			
36	20844	00	81	105522	75	124	247297	33			
37	22018	08	82	108143	33	125	251301	75			
38	23224	33	83	110798	08	126	255339	00			
39	24462	75	84	113484	00	127	259408	08			
40	25733	33	85	116202	08	128	263509	33			
41	27036	08	86	118952	33	129	266643	00			
42	28371	00	87	121734	75	130	271808	33			
43	29738	08	88	124549	33						
44	31137	33									
45	32568	75									

131	276006.	08
132	280236.	00
133	284498.	08
134	288792.	33
135	293119.	00
136	297477.	33
137	301868.	08
138	306291.	00
139	310746.	08
140	315233.	33
141	319752.	75
142	323304.	33
143	328888.	08
144	333504	00
145	338152	08
146	342831	33
147	347544	75
148	352289	33
149	357066	08
150	361875	00
151	366716	08
152	371589	33
153	376494	75
154	381432	33
155	386392	08
156	391404	00
157	396438.	08
158	401504	33
159	406602	75
160	411733	33
161	416896	08
162	422091.	00
163	427284.	75
164	432477	33
165		

How many times will be the Time of a Ball that Descends freely by the Gravity from the Height of Two Miles more than the Descent of the same Ball in 1 Min.

1760
3
5280

10560 fal in two Miles 25 6/10
9703 D° 1 — 24 6/10
857

5280 fal in 1 Mile 18 3/10
4703 17 3/10
577 (827 (1 1/2 time
250

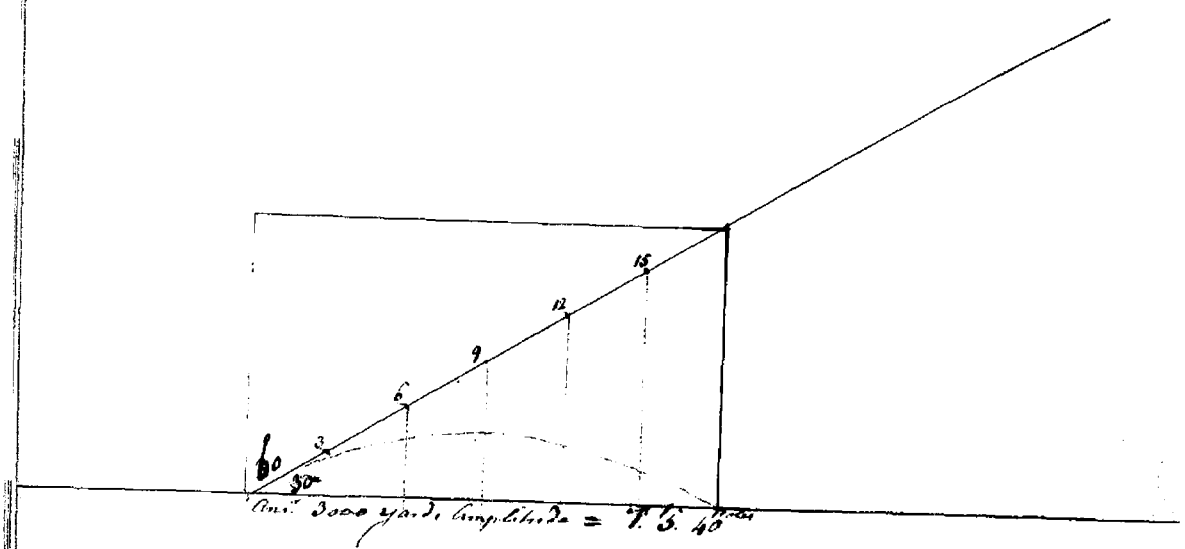
If a Ball Descends from such a Height that it be two Minutes in falling & the same Ball at another time Descend from such a Height that it be but 1 Minute in falling with how many times the former will the Ball come to the Ground in the former Case more than the latter

2 Minutes Descent — — 231600 / 227756 / 3844 / 846
1 D. Descents — — 1924 / 1844 2. 16

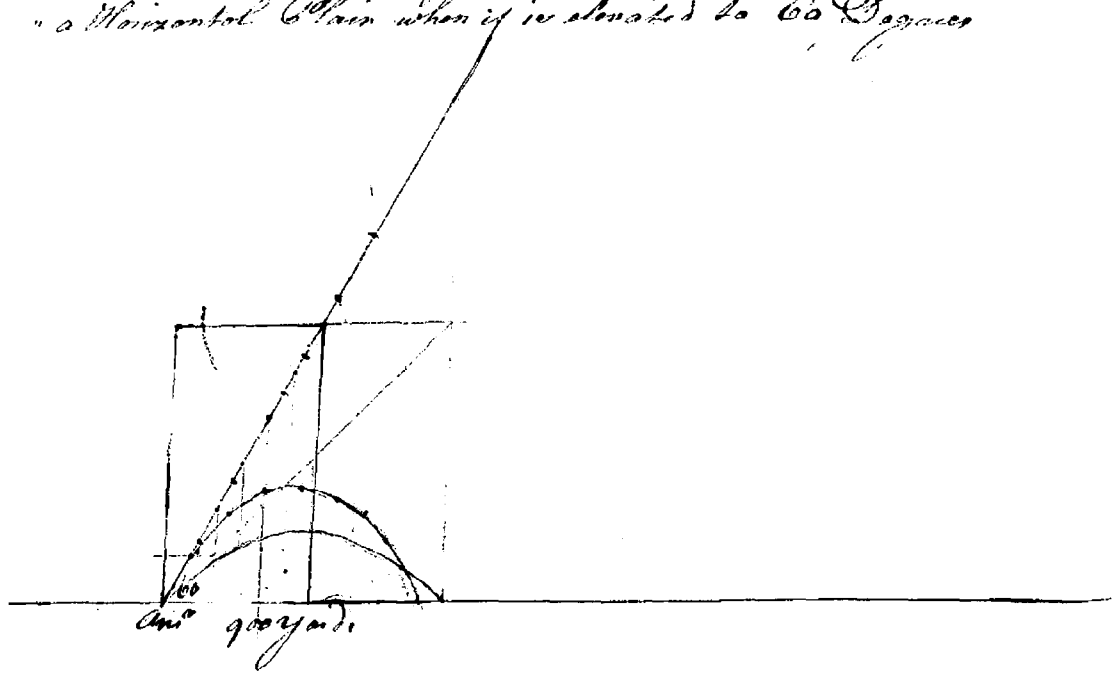
60 Seconds Descents 57900
59 D. D. D. 55986
former 1924

Dnc. The Proportion — as 2. 1

3 If the Impetus of a Piece of Ordinance be such that it will Project a Ball Perpendicularly 3 Miles high what will be the Amplitude or Range on a Horizontal Plain if it be Elevated 30 Degrees above the Horizon



4 If the Impetus of a Piece of Ordinance be such that it would throw a Shell One Mile on a Horizontal Plain when the Piece of Ordinance is elevated 45 Degrees how far will it throw a Shell on a Horizontal Plain when it is elevated to 60 Degrees



If
a Tower be 400 Yards high & a Piece of Ordinance be plaid at the
Distance of big a Mile from the Bottom of the Tower also with an Elevation
of 45 Degrees Impetus Capable of throwing it 2 Miles on a Horizontal Plain
I want to know whether it will hit the Tower Somewhat Near.

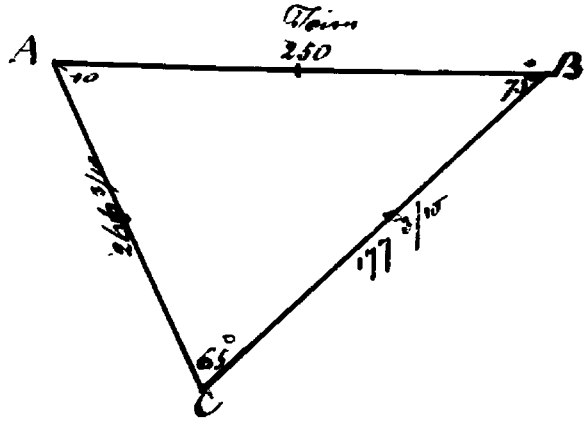
Sometimes the Projection is to be made over Ascending & Descending Planes in which Cases the Triangle circumscribing the Projection is to be a right angled Triangle but an oblique one in which Case obliqne plane Trigonometry or the Doctrine of plain Triangles which are not right angled must be Introduced the Generall Rejections of which are as follows

Case 1st

In the Triangle A B C is given the angle A 40° the Side A B 250 the angle B 75° Required the Side B C & the Side A C

180
75
40
115
115
65

65° 9.957276
250 2.397940
40° 9.808067
12.206007
77 3/10 = 2.248731



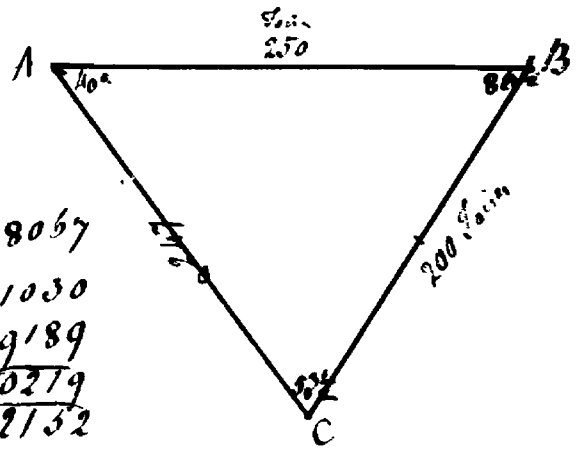
65° 9.957276
250 2.397940
75° 9.984943
12.382883
2.425607

2 Given the angle A 40° the Side A B Tons 250 & Side B C 200 Tons required

53 1/2
40
93 1/2

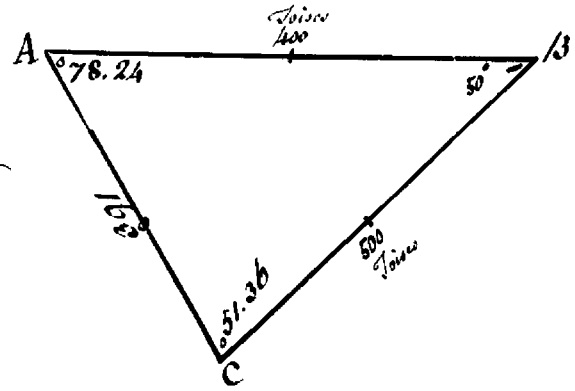
180
93 1/2
86 1/2

Tons
200 2.301030
40° 9.808067
250 2.397940
12.206007
53 1/2 9.904977



40° 9.808067
200 2.301030
86 1/2 9.999189
12.200219
247 = 2.392152

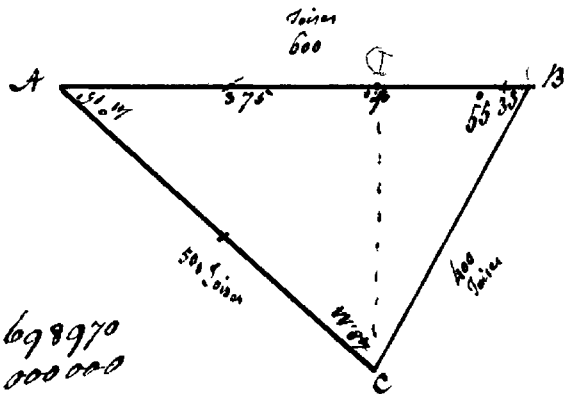
3 Given the Side A B 400 Toises & the Angle B 50° & the Side B C 500 Toises to find the Rest



As Sum of Sides 900 — 2 954242
to Difference Sides 100 — 2 000000
so Tan ½ Sum of ∠s 65° — 10 331327
to Tan ½ Diff of ∠s 13 24 — 9 377085
78.24
51. 36

As Sin 51.36° — 9. 894146
to 400 — 2 602060
Sin 50° — 9. 884254
12. 480314
391 = — 2. 592168

4 Given the three Sides AB 600 Toises BC 500 & AB 600 to find the Angles



Toises
As 600 — 2. 778151
to 900 — 2. 954242
so 100. — 2. 000000
4. 954242
150 = — 2. 176091

As Base 300
to Sq Base 75
makes Sq Base 375

Toises
As 500 — 2. 698970
to 90° — 10. 000000
so 375. — 2. 574031
48.44 = — 9. 875061

As 400. — 2. 602060
to 41. 16 — 9. 819257
so 500 — 2. 698970
12. 518227
55.33 = — 9. 916167

Calculation of Logarithms

vb

1

In the aforegoing Triangle A B C were given the Angle A 54° the Side A B 250 Toises the Angle B 86° required the Side B. C & the Side A C

As the Sine 54°		9. 907958	As Sine 54°		9. 907958
to 250 Toises		2. 397940	to 250 Toises		2. 397940
so Sine 86°		9. 998941	so Sine 40°		9. 808067
		12. 396881			12. 206067
to 308 9/10 Toises		2. 488923	to 198 6/10 Toises		2. 298149

6

2

Given the Side A B 100 Toises the Side B. C 500 & the Angle B 50°
to find the Rest

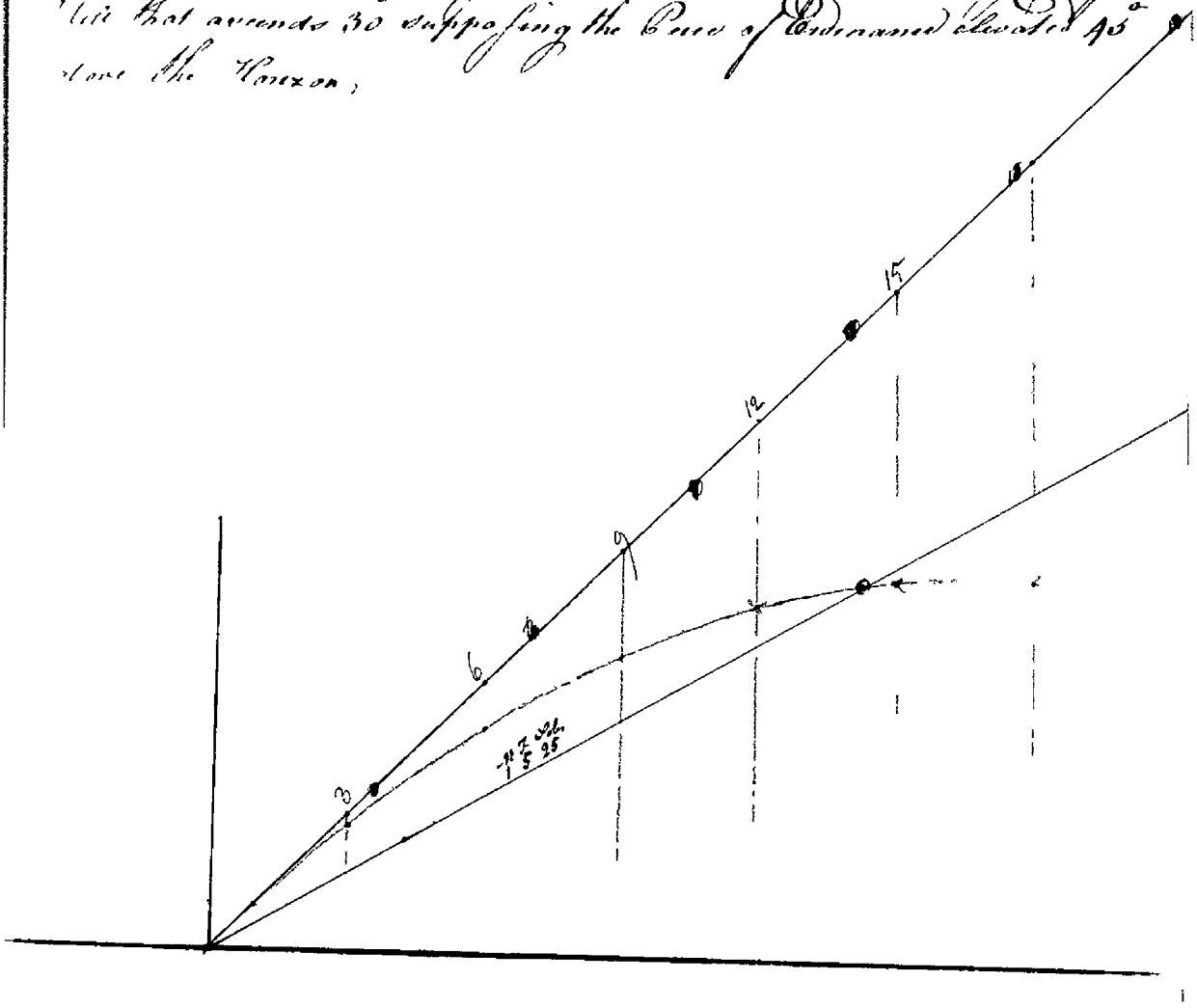
As the Sum of Sides	900 Toises	2. 954242	As Sine	51. 36	9. 894146
to D. of Sides	100.	2. 000000	to	400 Toises	2. 602060
so Tan. ½ Sum of L.	65°	10. 331327	so Sine	50	9. 884254
to Tan. ½ Diff of L	13. 24′	9. 377083	to D.	A C	12. 486314
	78. 24		391 Toises		2. 592168
	51. 36				

Given the 3 Sides A 400 Toises B 500 & C 600 to find the Angles

As the Sum	1500	2. 778151	As	500	2. 698970
to Sum of Sides	900	2. 954242	to Sine	90°	10. 000000
so D. of Sides	100	2. 000000	so	375	2. 574031
to D. of ½ Sum	150	2. 176091	to Sine	41. 25′	9. 872061
	75				
	300				
	375				

As	400	2. 602060
to Sine	41. 25′	9. 820549
so	500	2. 698970
		12. 319519
		9. 917459

The Impetus of a Piece of Ordnance is such that it will throw a Ball 1 Mile Perpendicularly 2 Miles where it will fall on the Side of a Hill that ascends 30° supposing the Piece of Ordnance elevated 45° above the Horizon;



14

1. Given the Elevation & Velocity to find the time of Flight & Amplitude over a Horizontal Plain

Rule

To the Log. Sine of Elevation add the Log of the Velocity & from the Sum Subtract the Log. 16'11 = 1.20637 the Remainder is the Log of the time of Flight

To the Log of the time of flight add the Log. Co-sine of the Elevation & the Log. of the Velocity their Sum is the Log. of the Amplitude

Example

A Mortar Piece is Elevated 50° above the Horizon & projects a Shell with the Velocity of 800 feet in a Second of time. Quere how many Seconds the Shell will be in motion & what Distance it will be thrown in a Horizontal Plain

Operation

El. 50° Sine —	9.884254 Log time ft	1.58097	
Vel. 800 feet	2.903090 Co-sine El. 50°	9.808067	
Log 16'11 — — —	12.787344	2.903090	
Seconds	1.20637	19695 =	4.19273
38.5	= 1.58097		

60

2 Given the Amplitude & Velocity to find the Angle of Elevation, over a Horizontal Plain.

Rule

To the Log. of 1760 yds = 1.20637 add the Log. of the Amplitude from the Sum subtract the doubled Log of the Velocity & find the absolute Number answering the Remainder, for which absolute Number find amongst the Natural Sines in the Line of Elevation.

Example

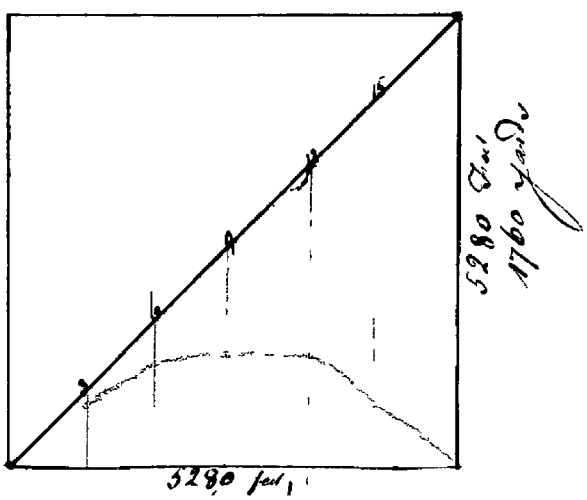
The Velocity of a Piece of Ordnance is 400 feet & its Distance from an Object on a Horizontal Plain two Miles, what the Elevation

Operation

$\frac{1760_2}{4280}$

	1.20637	400 = 260206	$\frac{1760_2}{5520_3}$
10560 =	4.02366	2	
	5.23003	5.20412	10560
	5.20412		
$\frac{1}{2}\frac{1061}{530}$	0.02591 =	32.4	° ′

However many Degrees high must a Mortar Piece be Elevated to Cast a Shell 1 Mile from the Place of Projection on a Level Plain & to fall from the greatest height that it reaches to one Mile



3

Given the Amplitude & Elevation to find the time of Flight & Velocity

Rule

To the Log. Sine of the Elevation add the Log. of the Amplitude & from their Sum subtract the Log of 16'/s = 1.20637 & the Log Co Sine of the Elevation & the Remaining Log. is the Log of the time of Flight

To the Log of the time of Flight add the Log of 16'/s = 1.20637 & from their Sum take the Log Sine of the Elevation the Remainder is the Log of the Velocity

Example.

A piece of Ordnance to Elevate 45° & its Horizontal Amplitude 1760 Feet Quere the time of Flight & Velocity

45°	9.849485
1760	3.245513
	13.094998
	1.20637
	11.88862
	9.84948
	2.03914
	1.01957

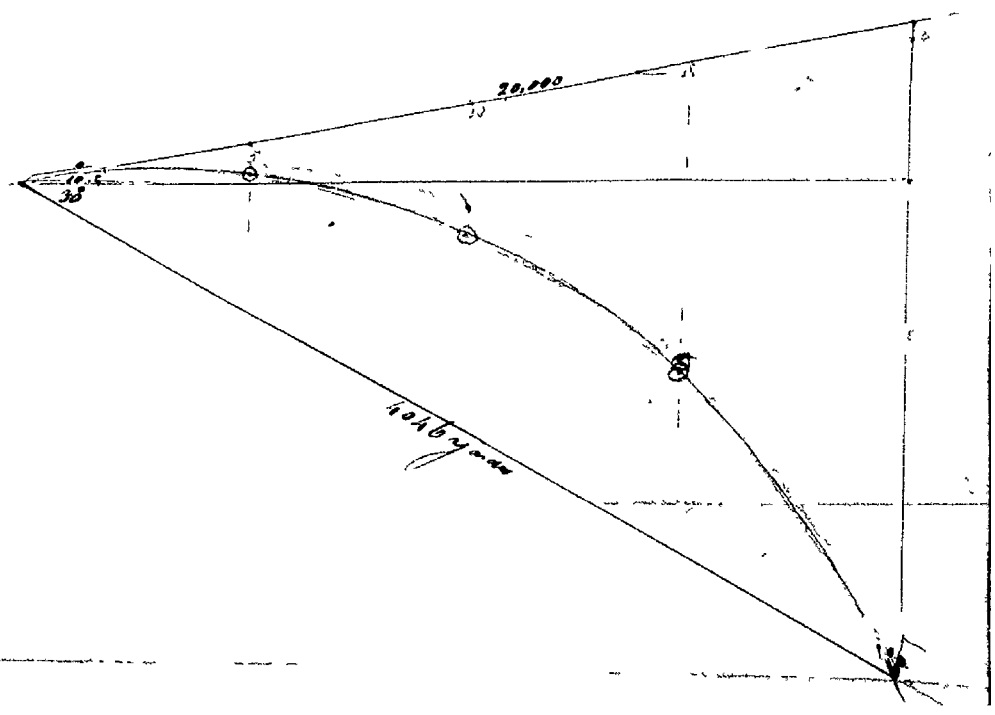
Secon/s
10.46/10 = 1.01957
16/1/6 = 1.20637
2.22594
9.84948
2.37646 = 238 Secon/s

If the Impetus of a Body of Ordnance be such that it projects a 13.11 1000 feet in a Second of time & to be intended to hit a Mark, in 20 Seconds of time on the Side of a Hill downwards which descends 30° below the Horizon, & at the Distance of 4046 Yards

Quere the Elevation, the Piece of Ordnance is to have above the Horizon

90°	10.000000	Co Sin 30°	9.698970
D 4046	3.607026	To 2023	3.305816
30°	9.698970	So Sin 60°	9.937531
	13.305996		13.243347
D 2023	= 3.305996	3502	= 3.544377

Co	20.000	4.301030
	90°	10.000000
	3502	3.544377
		13.544377
	10.5′	= 9.243347



If a Piece of Ordnance be Elevated 45° above the Horizon & pointed over a Slope Hill which descends 30° below the Plain of Ascension into which a Ball to the Distance of a Mile on the Said Horizontal Plain, which is 2023 Yards on the Slope of the Hill Quere the Velocity of the Ball & the time it is in Motion

Sin 60°	9.939697	60°	9.939697
1760 Yds	3.245513	1760 Y.	3.245513
30°	9.698970	90°	10.000000
	12.944483		13.245513
1011½	= 3.004786	2023	= 3.305816

Sin 45°	9.849485
2023 Y.	3.305816
60°	9.939697
	13.245513
2489	= 3.396028

But a more General Theorum for calculating the Horizontal Distances as as follows Viz. The Horizontal Amplitudes are as the Sines of the Double Angles of Elevation holding at the same time that the Amplitudes of any Number of Degrees of Elevation above 45 are equal to those of the same Number of Degrees under 45°

Example

If a Piece of Ordnance being Elevated ten Degrees above the Horizon throws a Shell to the Distance of 1 Mile on a Horizontal Plain how far will it throw the Shell on the same Plain being elevated 30°

As Sine	20°	9.534052
to	17607	3.245513
So	60°	9.937531
So		13.183044
4457	=	3.648992

Suppose a Piece of Ordnance to throw a Shell 2 when Elevated 45° how far will it throw the same under an Elevation of 60°

As	90° --	10.000000
to	3520.	3.546543
So	60°	9.937531
So		13.484074
3050	=	3.484074

END